Comparing annuity options at retirement

by

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Declaration

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Abstract

In this thesis, based on historical data, a comparative study is conducted of various annuity strategies for South African males who retired during the 30 years from 1960 to 1989. To this end, the present values of the monthly cash flows provided by different annuity strategies are calculated and compared in order to ascertain which strategy would have provided the largest financial benefits. In contrast to previously held general beliefs, the calculations demonstrate that pure living annuity strategies are superior to composite annuity strategies, which in turn outperform switching annuity strategies, whereas pure life annuities yield the lowest return.

Keywords

living annuities

life annuities

composite annuity strategies

switching annuity strategies

comparative study

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List of abbreviations and acronyms

ALBI	All Bond Index
ASSA	Actuarial Society of South Africa
ASISA	Association for Savings and Investment South Africa
BESA	Bond Exchange of South Africa
CPI	Consumer Price Index
CRRA	constant relative risk aversion
EPV	expected present value
GLUM	generalised logarithmic utility model
GBM	geometric Brownian motion
ILLA	investment linked living annuity
IRA	individual retirement account
JSE	Johannesburg Stock Exchange
KPI	key performance indicator
LISP	Linked Investment Service Provider
LOA	Life Offices Association of South Africa
NIF	net investment factor
NOV	number of victories
RCAD	remaining capital at death
RODA	real option to delay annuitisation
RRA	relative risk averse
RRSPs	registered retirement savings products
RRIFs	registered retirement income funds
SA	South Africa
SARB	South African Reserve Bank
SARS	South African Revenue Service
StatsSA	Statistics South Africa
UK	United Kingdom
USA	United States of America
VAT	value-added tax

Chapter 1

Introduction

South African individuals employed in the formal sector are likely to be members of their employers' retirement funds as a condition of employment. One of employers' main goals in setting up retirement funds is to ensure that employees receive a benefit at retirement which will enable them to purchase an income for life in order to maintain their standard of living.

There is an array of options available to retirees looking to purchase an income for life, and according to Goemans and Ncube (2008), there is a definite need for further research with respect to annuity options in the South African context. Most individuals purchase either a life or a living annuity at retirement. This decision is often made without quantifying the potential benefits and risks of all the annuity options on offer (Goemans & Ncube, 2008: i). In addition to investing in either life or living annuities, South African legislation allows retirees to follow alternative or mixed annuity strategies, which include composite and switching annuity strategies. To the author's knowledge, the performance of different annuity strategies in the South African context, as measured according to historical data, has not been compared in existing literature.

The purpose of this study is therefore to establish which of various annuity strategies would have been best to follow by South African males, aged 55, 60 and 65 respectively, who retired in the 30 years from 1960 to 1989. To this end the present values of the monthly cash flows provided by nine living annuity strategies (three drawdown strategies combined with three asset allocations), two life annuity strategies (a level annuity and an annuity increasing by 5% each year), 18 composite annuity strategies (nine living annuity strategies combined with two life annuity strategies), and 18 switching annuity strategies (nine living annuity strategies switched to two life annuity strategies) were calculated in order to ascertain which strategy provided the largest financial benefits in present value terms.

For comparative purposes, this study constructed living annuities as if they had been available since 1960, even though they were only formally launched in the 1990s. Furthermore, with-profit annuities, as well as inflation-linked life annuities were excluded from the study, due to their short history.

It was assumed that the male annuitants (aged 55, 60 and 65) retired every year, at the beginning of that year, during the period 1960 to 1989, and that their life expectancy was that of the a

(55) life mortality table as published by the Cambridge University Press in 1953 (Botha *et al.*, 2011: 1056). In terms of section 10A of the Income Tax Act 52 of 1962 (Republic of South Africa, 1962), the a (55) life mortality table (Botha *et al.*, 2011: 1056) is used when calculating the capital element of a voluntary life annuity. According to this mortality table, a male aged 55 has a life expectancy of 21.445 years, a male aged 60 has a life expectancy of 17.520 years and a male aged 65 has a life expectancy of 13.936 years. For the purpose of this study these life expectancies were rounded off to the nearest year. Thus it was assumed that the male aged 55, 60 and 65 had a life expectancy of 21, 18 and 14 years respectively.

As this study is based on historical data available up to December 2010, a sub-period of 30 years was used (1960 to 1989) to ensure that the time period includes the expected date of decease of a male.

The present value of cash flows was calculated per R1 million invested and living annuity portfolios were rebalanced annually to maintain asset allocations.

For the living annuity strategies, the present values of cash flows for 810 (three drawdown strategies combined with three asset allocations for three retirement ages over 30 years) were calculated. For the life annuity strategies, the present values of cash flows for 180 combinations (two life annuity strategies for three retirement ages over 30 years) were calculated.

There were 1620 combinations (nine living annuity strategies combined with two life annuity strategies for three retirement ages over 30 years) for the composite annuity strategy, whereas the switching annuity strategy consisted of 1620 combinations (nine living annuity strategies switched to two life annuity strategies for three retirement ages over 30 years).

The contribution of this study is to aid future retirees in selecting the most beneficial annuity strategies.

In Chapter 2, a theoretical framework for the legislation governing retirement funds and annuity options in South Africa is presented. This is followed by a literature review in Chapter 3, where both international and national research in this field is explored. Chapter 4 describes the methodology followed to conduct the study, followed by a discussion of the results in Chapter 5. Finally, in Chapter 6, a conclusion is given of the results offered.

Chapter 2

Theoretical framework

Legislation governing retirement funds and annuity options in South Africa needs to be understood before these options can be analysed and compared. In Section 2.1 some relevant aspects of legislation governing the different types of retirement funds in South Africa are discussed. This will help retirees, in consultation with their financial planners, to make an informed decision at retirement. In Section 2.2 the various annuity options available to an individual at retirement, as well as some of the applicable legislation, are discussed briefly. This will aid financial planners in giving advice to individuals nearing retirement in their selection of the most appropriate annuity options. In Section 2.3 the reasons for the international trend towards retirees preferring to self-annuitise, in contrast to purchasing an annuity underwritten by an insurer, are examined. Section 2.4 follows with an exploration of behavioural biases in retirement and possible solutions to the money death problem. "Money death" refers to the risk that a pensioner may run out of money in retirement.

2.1 South African retirement fund legislation

Retirement funds in South Africa can be split into two broad categories, namely occupational schemes and individual schemes. Two retirement funds resort under occupational schemes, namely pension funds and provident funds. In contrast, individual schemes are available to those members who do not belong to an occupational scheme, as well as to individuals who wish to make additional retirement savings outside of an occupational scheme and / or who wish to preserve money paid out from an occupational scheme (Botha, Rossini, Geach & Goodall, 2009: 869). Retirement annuity funds, pension preservation funds and provident preservation funds resort under individual schemes.

The Pension Funds Act 24 of 1956 (Republic of South Africa, 1956) does not distinguish between the different types of retirement funds in South Africa. These distinctions are explained in the Income Tax Act 52 of 1962 (Republic of South Africa, 1962). In terms of the definitions of pension funds, pension preservation funds and retirement annuity funds as defined in Section 1 (dd) of the Income Tax Act 52 of 1962 (Republic of South Africa, 1962), members may commute a maximum of one-third of their benefits at retirement from employment by way of a lump sum

(except where two-thirds of the total value does not exceed R50 000 or where the employee is deceased). The remaining two-thirds must be used to purchase a compulsory annuity (Marx & Hanekom, 2009: 795).

The main difference between provident funds or provident preservation funds and pension funds, pension preservation funds, or retirement annuity funds, is that sub-paragraph (dd) of Section 1 to the Income Tax Act 52 of 1962 (Republic of South Africa, 1962) is not included in the definition of provident funds. This means that whereas in the case of pension funds, pension preservation funds or retirement annuity funds the member is required to purchase an annuity with at least two-thirds of the benefit at retirement, in the case of provident funds or provident preservation funds, the member may take the entire benefit in cash (Botha *et al.*, 2009: 872).

If the rules of provident funds do make provision for the purchase of an annuity with either a part of or the full retirement fund interest, the annuity thus purchased will, for all practical purposes, also be treated as a compulsory annuity in spite of the fact that the compulsion is contained in the rules of the fund and not in the provisions of the Income Tax Act 52 of 1962 (Republic of South Africa, 1962). Compulsory annuities can, however, only be purchased with amounts which have not already been paid to the member in cash and will exclude any amount commuted by the member in terms of the rules of the fund (Marx & Hanekom, 2009: 795).

Should the rules of provident funds not make provision for the purchase of an annuity, voluntary annuities may be purchased with either a part of or the full retirement fund interest after paying tax on the amount according to the Second Schedule to the Income Tax Act 52 of 1962 (Republic of South Africa, 1962).

Paragraph (e) of the definition of "gross income" in Section 1 of the Income Tax Act 52 of 1962 (Republic of South Africa, 1962) specifically includes a "retirement fund lump sum benefit". A "retirement fund lump sum benefit" is defined as an amount determined in terms of paragraph 2(1)(a) of the Second Schedule to the Income Tax Act 52 of 1962 (Republic of South Africa, 1962). This amount refers to the taxable portion of the retirement fund lump sum benefit, which is the amount that remains after deducting the deductible amounts under paragraph 5 of the Second Schedule to the Income Tax Act 52 of 1962 (Republic of South Africa, 1962). The taxable portion is then taxed according to a separate tax table that was introduced with effect from 1 March 2009 (Botha *et al.*, 2009: 850-851).

In terms of the definition of "gross income" as it appears in Section 1, subparagraph (a) of the Income Tax Act 52 of 1962 (Republic of South Africa, 1962), any amount received by a taxpayer that constitutes an annuity must be included in gross income. The capital portion of voluntary annuities, however, is exempt from income tax in terms of Section 10A of the Income Tax Act 52 of 1962 (Republic of South Africa, 1962). The capital element of an annuity payment is determined in accordance with the Formula 2.1:

$$Y = \frac{A}{B} \times C \qquad \text{(Formula 2.1)}$$

where "A" represents the cash consideration, "B" represents the total payment expected to be made by the insurer over the life expectancy of the annuitant, or over the term of the annuity, and "C" represents the amount of the annuity. Should a taxpayer receive any lump sum in commutation of a voluntary annuity contract, the capital element of such an amount is determined in accordance with Formula 2.2:

$$X = A - D \qquad \text{(Formula 2.2)}$$

where "X" represents the capital amount to be determined, "A" represents the cash consideration, and "D" represents the capital amounts payable under the annuity contract prior to the commutation or termination thereof.

Retirement funds are permitted to provide an annuity to a retiring member by paying the annuity directly, or by purchasing the annuity in the name of the fund from a South African long-term insurer or investment house, or by purchasing the annuity in the name of a retiring member from a South African long-term insurer or investment house. While the aforementioned methods may be provided for in the rules of a retirement fund, a member may select only one of them and not a combination (General Note 18 to the Income Tax Act 52 of 1962, (Republic of South Africa, 1962)).

According to General Note 18 to the Income Tax Act 52 of 1962 (Republic of South Africa, 1962), it is important to note that, in whichever way the annuity is provided, the annuity must be compulsory, non-commutable, payable for and based on the lifetime of the retiring member and may not be transferred, assigned, reduced, hypothecated or attached by creditors as contemplated by the provisions of Sections 37A and 37B of the Pension Funds Act 24 of 1956 (Republic of South Africa, 1956).

Occupational schemes (i.e. pension funds or provident funds) can be structured on a defined contribution or defined benefit basis.

Under a defined contribution fund the contributions made by the member and the employer are defined as a percentage of the member's current salary. The ultimate benefit, which is payable to a member is a function of the contributions paid to the fund, costs and investment performance. In this type of funding structure, the member bears the risk of poor investment returns and increasing fund costs. In a defined contribution scheme the employer will in most cases not accept responsibility for the investment returns and longevity risks associated with a pension benefit as is the case with defined benefit schemes (Botha *et al.*, 2009: 891-894). Hence, a member of a defined contribution fund is fully responsible for providing himself or herself with a pension for life.

In the case of a defined benefit fund, the benefit to which the member is entitled at retirement is not based on the contributions plus growth less costs method. Although the member may, together with the employer, contribute to the fund, the benefits payable are not calculated as a function of the above factors. The retirement benefit is based on the member's final salary and is calculated by using a formula which is incorporated in the rules of the fund (e.g. 2% multiplied by years of membership multiplied by final salary). In this type of funding structure, the employer bears the risk of poor investment performance and rising costs. The employer is responsible for providing the member with a pension for the duration of his/her lifetime after retirement (Botha *et al.*, 2009: 891-894).

There has been a shift away from defined benefit to defined contribution pension schemes that has taken place not only in South Africa, but also in many countries elsewhere over the past few decades (National Treasury, 2007).

After retiring from retirement annuity funds, pension preservation funds, or provident preserva-

tion funds, the member also bears the risk of poor investment returns and increasing fund costs, and is fully responsible for providing himself or herself with an income for life.

2.2 Annuity options in South Africa

An annuity is any amount that is payable at regular intervals and in respect of which a designated entity has a right to receive the amount, and another designated entity is under an obligation to pay the amount (Botha *et al.*, 2009).

There are two types of compulsory annuities in South Africa, namely conventional guaranteed life annuities, also referred to as annuitisation, and living annuities, also referred to as self-annuitisation, the first of which is treated in Section 2.2.1, and the second in Section 2.2.2.

2.2.1 Conventional (traditional) guaranteed life annuities

A life annuity is defined by Brown (2001) as a contract between an insured person and an insurer that guarantees the payment of a periodic amount for as long as the annuitant is alive, in exchange for a non-refundable initial capital sum.

The main characteristic of a life annuity is that it protects the annuitant against the risk of outliving accumulated savings in retirement, by pooling longevity risk across a group of annuity purchasers (Brown, 2001). Consequently, in return for a capital sum, the insurer assumes both the investment and the mortality risk. Hence, should the annuitant die after the normal life expectancy, the insurer will register a loss in respect of that life annuity policy, but if the annuitant dies earlier, the insurer makes a profit (Marx & Hanekom, 2009: 795). According to Lodhia and Swanepoel (2012: 123) this is a common misconception. They put forward that the insurer prices on the life expectancy of the entire pool. If their assumption of the life expectancy of members is correct, the insurer will make neither a profit, nor a loss, as proceeds from early deaths will perfectly offset the cost of the longer income stream payable to people who survive beyond the average life expectancy. The insurer only stands to profit if the average age at death is lower than the assumption used for the entire pool. The assumption may be biased to benefit the insurer.

Conventional annuities are typically marketed with the following permutations as discussed in Marx and Hanekom (2009: 797-798):

a. Standard single life annuity: an annuity on the life of one person payable until the death of that person;

b. Joint and survivor annuity: a life annuity payable until the death of one life insured on condition that a further (often reduced) annuity will become payable to a second life insured (typically a spouse or partner) if that life insured survives the first life insured;

c. Guaranteed term annuity: an annuity payable until the death of the life insured provided that payment is guaranteed for a specified term, typically five or ten years. Should the

life insured die during the guarantee period, beneficiaries or nominees would continue to receive the benefit for the duration of the guarantee period.

Variations and combinations of these annuities are possible.

Conventional guaranteed life annuity rates are dependent mainly on the following four factors (Cameron, 2009):

a. Gender: since the expected life span of a female exceeds that of a male, females will receive a lower pension than males of the same age.

b. Age: the older the annuitant, the shorter his/her life expectancy and the higher the pension he/she will receive.

c. Choice of annuity and permutation: a level annuity (see Section 2.2.1.1) will for example provide the annuitant with a higher initial annuity compared to an inflation-linked annuity (see Section 2.2.1.2(b)). Similarly, an annuity with a guarantee term will provide the annuitant with a lower annuity compared to an annuity without a guarantee term.

d. Interest rate at date of purchase: the underlying assets of guaranteed life annuities are usually fixed interest government bonds. Conventional guaranteed life annuity rates consequently depend on interest rates. If interest rates are high, annuity rates offered on newly issued annuities will be correspondingly high. Once issued though, the terms are fixed, and are not affected by any subsequent interest rate movements (Nienaber & Reinecke, 2009).

Next, the main types of conventional guaranteed life annuities are discussed (Personal Finance, 2010).

2.2.1.1 Level annuities

The amount the annuitant receives is level in nominal terms, i.e. the annuitant receives the same amount every month until his/her death. The annuitant's biggest threat is inflation, which will reduce the purchasing power of his/her pension every year (Brown, Mitchell & Poterba, 2001). When the annuitant first starts to receive his/her pension, it will be comparably higher than the amount he/she could have received from another type of conventional guaranteed life annuity. However, within a few years, due to the effects of inflation, its purchasing power will be significantly lower than one of the other conventional guaranteed life annuities.

2.2.1.2 Annuities with a built-in annual income increase

These annuities increase by a predetermined amount each year with a view to counteracting the effect of inflation. The initial level of guaranteed income is reduced to fund the cost of the increases (Goemans & Ncube, 2008: 2). The annuitant has the following two choices:

a. Escalating annuities increase by a fixed percentage each year;

b. Inflation-linked annuities are linked to the inflation rate.

2.2.1.3 With-profits annuities

A new conventional annuity product was launched in the early 1990s, namely with-profits annuities.

The major difference between this product and the other types of conventional annuities is the fact that, in the case of with-profits annuities, increases in the annuity are not guaranteed. A portion of the capital is allocated to a profit participation account. This account is typically invested in an investment portfolio. Depending on the return of the profit participation account and the amount allocated thereto, the insurer declares pension increases which are used to enhance the annuity in order to mitigate the effect of inflation (Marx & Hanekom, 2009: 796).

When the profit participation account is providing good returns, a portion of these returns is held back for the poorer investment years. Consequently, when profit participation account returns are high, pension increases tend to be lower than overall market returns, with the difference being put into a bonus-smoothing reserve. When overall market returns are poor, pension increases tend to be higher than overall market returns, with the difference being made up from the bonus-smoothing reserve (Cameron, 2009).

An initial level of pension within a range based on the so-called discount purchase rate, pricing interest rate, or post-retirement interest rate can be chosen by the annuitant. The higher the rate, the higher the initial pension, but the lower the annual pension increase that can be expected (Cameron, 2009).

The following example will illustrate this principle: when a with-profits annuity is purchased with a discount rate of 4% and a gross return on the portfolio of 10% is achieved, the pension will consequently increase by approximately 6% per year. If, on the other hand, a discount rate of 6% had been chosen, and the gross return is once again 10%, the pension increase will be approximately 4% per year. The initial pension, however, would have been higher than the one with a discount rate of 4% (Cameron, 2009).

A low discount rate favours retirees who live longer, because eventually they will receive a larger pension than those who started off with a higher pension but received lower increases (Cameron, 2009).

The lower the discount rate selected, the more flexible the investment mandate can be. With lower discount rates, the investment mandate can be changed slightly to allow the life insurer

to invest more in equities, which could be expected to provide a higher return in the long run (Cameron, 2009).

Once a pension increase has been granted, it becomes part of the guaranteed pension (Cameron, 2009). The insurer thus carries the investment risk of maintaining the annuity including all previous increases, while the annuitant carries the investment risk of future increases (Nienaber & Reinecke, 2009: 347).

2.2.2 Living annuities

A living annuity, also referred to as an investment linked living annuity (ILLA), flexible annuity, or linked annuity in terms of Section 1 of the Income Tax Act 52 of 1962 (Republic of South Africa, 1962), is defined as the right of a member of a retirement fund to an annuity purchased at retirement from a life insurer or investment house.

The annual amount of the annuity is limited to an income drawdown percentage between 2.5% and 17.5% of the underlying investment amount net of costs. According to Government Notice 290 of 11 March 2009 the annuitant may elect a different income drawdown rate which will be applied on the revised fund value at the anniversary date of the annuity contract, provided it is within the set limits (SARS, 2009). This cap was imposed by the legislator in an attempt to preserve capital and ensure a longer-lasting income.

The amount of the annuity is not guaranteed by the life insurer or investment house.

On the death of the member, the underlying fund value may be paid to the nominee of the member as an annuity or lump sum. In the absence of a nominee it will be paid to the deceased member's estate.

The annuitant has the full flexibility to create a portfolio without having to adhere to the investment restrictions as described in Regulation 28 of the Pension Funds Act 24 of 1956 (Republic of South Africa, 1956). Therefore, the entire portfolio can be invested in offshore or in local equities. According to ASISA's (Association for Savings and Investment South Africa) Standard on Living Annuities issued in 2010 (ASISA, 2010), should the asset allocation deviate from the guidelines contained in Regulation 28 of the Pension Funds Act 24 of 1956 (Republic of South Africa, 1956), the annuitant may be at risk of either losing capital, or being unable to maintain current income levels.

Directive 135A, together with Directive 135 to the Long-Term Insurance Act 52 of 1998 (Republic of South Africa, 1998), provide an annuitant with an option to transfer his/her compulsory linked annuity policy to another long-term insurer at his/her request, and to convert a living annuity to a conventional life annuity. Once funds are transferred from a living annuity to a conventional life annuity, this cannot be reversed.

Purchasing more than one type of annuity may suit a retiree's needs and preferences at retirement. This would allow the retiree to utilise the advantages that many of the annuities offer.

According to the Revenue Laws Amendment Act 60 of 2008 (Republic of South Africa, 2008), should the value of assets from which an annuity is derived fall below R50 000, where a cash commutation was taken at the time that the annuity was effected, or R75 000 where no cash commutation was taken, the annuity may be commuted in full. It is proposed that the commutation will apply per insurer as opposed to per contract (Pillay, 2009: 1).

Providers of member-owned annuities do not have to determine who the dependants of the annuitant are. The member-owned annuity product providers only have to pay the benefits to a nominee, or failing which, to the annuitant's deceased estate. Providers of fund-owned annuities must distribute the remaining balance in the living annuity to the deceased's dependants and nominated beneficiaries in accordance with Section 37C of the Pension Funds Act 24 of 1956 (Republic of South Africa, 1956) (Marx & Hanekom, 2009: 797).

The income from a living annuity is dependent on the length of the annuitant's lifespan, the income drawdown rates and the actual investment performance.

Investing in a living annuity compared to a life annuity has many advantages. For example, living annuities provide greater liquidity, participation in capital market returns, possibly higher consumption while alive, and the chance of bequeathing assets in the event of early death. Unfortunately, these advantages afforded to annuitants invested in living annuities, in comparison to conventional guaranteed life annuities, come at a price. Annuitants fully shoulder the investment risk. It also offers no longevity pooling, therefore the retiree might run out of assets before his/her death (Horneff, Maurer, Mitchell & Dus, 2008).

Despite this, its popularity has risen significantly over the last decade in South Africa (Goemans & Ncube, 2008).

2.3 Annuitisation vs. self-annuitisation

In an informal survey a leading retirement funds adviser found that 75% of retiring South Africans chose not to annuitise, but warned that national rates might be lower as self-annuitsation tended to be an option only for more affluent retirees (Rusconi, 2006a). This number seems to have increased significantly over the past couple of years to 85%, according to ASISA (Lodhia & Swanepoel, 2012: 1).

Life annuities (or annuitisation) provide invaluable protection to individuals, insuring them against the risk of resources proving insufficient for a long life. Longevity insurance cannot be replicated by pure investment vehicles, such as living annuities (or self-annuitisation). As there is no maximum age in South Africa by which accumulated retirement savings must be converted to a life annuity if the self-annuitisation route is followed, risks to which individuals are being exposed are exacerbated with inadvisably high income drawdown rates (Rusconi, 2006a).

In an effort to solve the annuity puzzle, the following authors point out possible reasons why retirees may be reluctant to purchase life annuities:

a. There is a loss of liquidity as assets cannot be recovered after purchasing the annuity (Albrecht & Maurer, 2002: 2). There is also no facility to withdraw large amounts on occasion, to meet special expenses (Rusconi, 2006a: 22). In Browne, Milevsky and Salisbury (2003) a model to determine the liquidity premium demanded by the holder of an illiquid annuity is analysed.

b. There is no chance of bequeathing money to heirs, even in the case of an early death of the annuitant (Albrect & Maurer, 2002: 2). Rusconi (2006a) pointed out that the bequest motive dominated the thinking of South Africans who selected an income drawdown strategy. However, according to a study conducted by Gardner and Wadsworth (2004), of those United Kingdom (UK) retirees choosing not to annuitise, less than 40% were motivated by this reason.

c. Gardner and Wadsworth (2004) also found that the main reason for retirees in the UK not to annuitise, is their desire for flexibility and resulting control over their retirement fund assets and retirement income. Self-annuitisation in South Africa offers flexibility in terms of asset allocation, underlying investments, manager selection and income drawdown rates (Goemans & Ncube, 2008).

d. Rusconi (2006a) suggested that the level of interest rates in the economy plays an important role in a retiree's decision to annuitise or not. As stated in Section 2.2.1(d), annuity rates depend largely on the level of interest rates. The poor demand for life annuities in South Africa could therefore be attributed to falling interest rates.

e. Goemans and Ncube (2008) indicated that retirees choosing not to annuitise believe they can earn a risk premium above the matched returns provided by life annuities. The long period of economic growth from approximately 2003 up until 2007 in South Africa has created the illusion of wealth which supports the low demand for life annuities in South Africa (Rusconi, 2006a).

f. Commission rates for life annuities in South Africa are not high, as there is fierce competition amongst insurers. Subsequently financial planners have a strong financial incentive to rather recommend the income drawdown model with its potential of substantial financial reward for the financial planner (Rusconi, 2006a). This seems to be the case in the USA market as well (Reno, Graetz, Apfel, Lavery & Hill, 2005).

g. Rusconi (2006a) stated that falling levels of trust in South African insurers contributed to individuals' reluctance to annuitise. This was echoed by Gardner and Wadsworth (2004) in the UK market.

h. High life insurance company loadings arising from adverse selection could also be a factor. Adverse selection or anti-selection, resulting from asymmetry of information, rests on the premise that annuitants have knowledge of their own mortality risk that insurers find impossible to obtain. Subsequently, individuals who expect to live for a long time choose to annuitise, which in turn leads insurers to raise their prices in order to compensate (Mitchell, Poterba, Warshawsky & Brown, 1999). Evidence from South Africa, however, suggests that annuities are fairly and competitively priced (Rusconi, 2006b).

i. Pooling, the practice of treating all annuitants as a single group for pricing purposes (Rusconi, 2006b: 19), could be another reason. The disadvantage of pooling is that the unhealthy (and often poor) dying soon, subsidise the healthy (and often rich) living long lives. This is unlikely to apply to the South African context, as very few of the poor are currently purchasing annuities (Rusconi, 2006b).

j. Alternative support from government via social security or old age grants could also be a factor (Horneff *et al.*, 2008). This is unlikely to apply in the South African context.

k. Finally, the presence of the "family strategy", as posed by Schmeiser and Post (2005), according to which heirs are willing to bear the shortfall risk of the retiree's self-annuitisation, since they might benefit from a bequest, could be another reason for the unwillingness of retirees to purchase life annuities. It is highly questionable whether this applies in the South African context.

Goemans and Ncube (2008) put forward three possible reasons why a guaranteed life annuity option may be preferred by retirees:

a. The first reason is the security which this option provides. The annuitant does not have to carry the risk of poor investment returns, and of living longer than expected.

b. The concept of a life annuity is easily understood, since a fixed monthly payment is guaranteed by the life insurer, and since, moreover, no portfolio management is required from the annuitant.

c. Life annuity options provide the annuitant with certainty regarding any bequest, should either a joint-life, life cover, or guarantee option be added to the life annuity contract.

2.4 Behavioural bias in retirement and possible solutions to the money death problem

Kahneman and Tversky's (1979) "prospect theory" suggests that individuals are much more risk-averse when faced with the prospect of a loss, than they are risk-taking when the prospect is a gain, typically by a factor of two. This behavioural trap prompts retirees to take a much too conservative approach with regard to their assets in retirement. With improvements in healthcare, technology, and lifestyle choices, which in turn lead to longer life expectancies, retirees are falling into the trap of retreating to conservative asset allocations when investment returns are more critical than ever (The Brandes Institute, 2012).

According to conventional wisdom, older investors are often advised to preserve their capital by investing in low risk, fixed income investments, as it is believed that they will not have enough time to recover from market losses. This phenomenon is exacerbated by "herding", a behavioural bias where investors tend to follow the crowd. It is argued that for affluent retirees in good health, with a life expectancy in excess of the median retiree, this advice may be inappropriate, as it exposes them to the risk of outliving their assets (a.k.a the money death problem). To further support this theory, the concept of "real age" is introduced. "Real age" refers to a person's age by taking his/her health, lifestyle, as well as hereditary and environmental factors into account,

and could be much lower, or higher, than a person's chronological age (The Brandes Institute, 2012).

Another behavioural phenomenon known as "mental accounting" also affects retirees' risk aversion in retirement. Mental accounting refers to the act of separating an asset into different mental accounts. According to this bias, retirees will separate their retirement asset into a principal and income account. Retirees will subsequently invest in risky assets, such as equities in pursuit of high yields, to ensure adequate spending levels during their retirement years without dipping into their "principal account" (The Brandes Institute, 2012).

It is suggested that a better approach would be to focus on total return while managing the portfolio to avoid outliving one's money. The suggested investment guidelines that follow from the study are to:

- Hold a significant proportion of assets in high-return risky assets, e.g. equities;
- Diversify globally and by asset class; and
- Rebalance on a regular basis.

It is further suggested for healthier and wealthier individuals to follow two more investment guidelines, namely to emphasise income-producing investments within the maximum return objective, and to invest in longevity insurance, under 10% of total wealth. Longevity insurance in this context refers to deferred annuities, which are similar to South African life annuities, but differ in that deferred annuities only start paying out when the annuitant reaches old age, for example 85 years.

The USA is the only country where such deferred annuity policies are available and competition is limited there, as there are only two companies offering such products. Demand is equally low.

In this chapter a theoretical framework for the legislation governing retirement funds and annuity options in South Africa was presented. This is followed by a literature review in Chapter 3, where both international and national research in this field is explored.

Chapter 3

Literature review

3.1 Introduction

Horneff *et al.* (2008) identified 22 international studies comparing life annuity strategies and phased withdrawal plans. These studies differ along many dimensions as outlined in Table 3.1 and are organised in chronological order in Table 3.2.

Table 3.1: Dimensions used to organise previous studies

Category	**Framework type**	
	1	2
A	Utility framework	Shortfall framework
B	Risk neutral	Risk averse
C	Additive utility	Habit formation
D	Illiquid life annuities	Term life annuities
E	Constant annuity	Variable annuity
F	No bequest motive	Bequest utility
G	Constant asset mix	Dynamic asset mix
H	Deterministic asset model	Stochastic asset model
I	Deterministic interest rates	Stochastic interest rates
J	No inflation risk	Inflation risk
K	Annuity and financial wealth only	Human capital
L	Exogenous annuitisation strategy	Endogenous annuitisation strategy

Source: Horneff, Maurer, Mitchell & Dus, 2008.

Table 3.2: Previous studies comparing life annuity strategies and phased withdrawal plans

Year	Authors	Model features
1965	Yaari	Immediate annuitisation (constant life annuity).
		A1, (B1), (C1), D1, E1, F1, G1, H1, I1, J1, K1, L2
1975	Richard	Reverse instantaneous term life annuities.
		A1, B2, C1, D2, E2, F2, G2, H2, I1, K2, L2
1983	Merton	Immediate annuitisation; never opt for constant life annuity.
		A1, B2, C1, (D1), E2, F1, G1, H2, I1, J1, K1, L2
1998	Milevsky	Annuitisation when mortality drag is equal/greater than equity risk-premium.
		A2, B2, D1, E1, F1, G1, H2, I2, J1, K1, L1
1999	Kapur and Orszag	Gradual annuitisation (instantaneous term life annuities) full annuitisation when mortality drag is equal or greater than equity risk-premium.
		A1, B2, C1, D2, E1, F1, G2, H2, I1, J1, K1, L2
1999	Mitchell, Poterba, Warshawsky, and Brown	High demand for nominal annuities.
		A1, B2, C1, D1, E1, F1, G1 H2, I1, J2, K1, L1
2001	Brown, Mitchell and Poterba	Strong appeal of variable equity-linked annuities.
		A1, B2, C1, D1, E1 or E2, F1, G1, H2, I1, J2, K1, L1
2002	Charupat and Milevsky	Constant rebalancing inside the variable annuity.
		A1, B2, C1, D1, E1 and E2, F1, G2, H2, I1, J1, K1, L1
2003	Blake, Cairns, and Dowd	Optimal deterministic switching and stochastic switching; withdrawal plan before $\underline{T}$ (includes optimised static asset mix); $\underline{T}$ depends on risk aversion and bequest utility.
		A1, B2, C1 or C2, D1, E1 or E2, F2, G1, H2, I1,J1, K1, L1 and L2
2003	Browne, Milevsky, and Salisbury	Illiquidity premium is considerable high for purchase-and-hold annuity strategies.
		A1, B2, C1, D1, E1 and E2, F1, G2, H2, I1, J1, K1, L1
2003	Milevsky and Young	Optimal deterministic switching (includes optimised dynamic asset mix); closed-form solution for switching case; optimal gradual annuitisation.
		A1, B2, C1, D1, E1 or E2, F1 or F2, G2, H2, I1, J1, K1, L1 or L2
2004	Gerrard, Haberman, and Vigna	Exogenous annuitisation at 75; self-annuitisation strategy before; assumes disutility.
		A1 and A2, B2, D1, E1, F1, G2, H2, I1, J1, K1, L1
2005	Davidoff, Brown and Diamond	Immediate annuitisation with Arrow Debreu term life annuities.

Table 3.2: Previous studies comparing life annuity strategies and phased withdrawal plans (continued)

Year	Authors	Model features
		A1, B2, C1 or C2, D1 or D2, E1 or E2, F1 or F2, G2, H2, I1, J1, K1, L2
2005	Dus, Maurer, and Mitchell	Switch at regulatory deterministic time $\underline{T}$; withdrawal plan before $\underline{T}$ includes optimal constant asset mix.
		A2, B2, D1, E1, F2, G1, H2, I1, J1, K1, L1
2005	Kingston and Thorp	Complete deterministic switching; closed-form solution.
		A1, B2, C1 and C2, D1, E1, F1, G2, H2, I1, J1, K1, L2 and L1
2006	Babbel and Merrill	Initial annuitisation; solution for a withdrawal plan including some annuitised wealth.
		A1, B2, C1, D1, E1, G2, H2, I1, J1, K1, L1 and L2
2006a	Horneff, Maurer, and Stamos	Gradual annuitisation starts before retirement. (working paper 2006; published 2008)
		A1, B2, C1 or C2, D1, E1, (F2), G2, H2, I1, J1, K2, L2
2006b	Horneff, Maurer, and Stamos	Optimal gradual, partial switching, and complete switching strategies. (working paper 2006; published 2008)
		A1, B2, C1 or C2, D1, E1, (F2), G2, H2, I1, J1, K2, L2 and L1
2006	Koijen, Nijman, and Werker	Complete asset universe; force individuals to fully annuitise at age 65.
		A1, B2, C1, D1, E1 and E2, F1, G2, H2, I2, J2, K2, L1
2006	Milevsky, Moore, and Young	Complete stochastic switching (includes optimised dynamic asset mix).
		A2, B2, D1, E1, F1, G2, H2, I1, J1, K1, L2
2007	Milevsky and Young	Dominance arguments when to purchase life annuities.
		D1, E1 and E2, F1, G1, H2, I1, J1, K1, L1 and L2
	Present paper	Withdrawal plan before $\underline{T}$ (includes static asset mix); optimal immediate annuitisation, optimal deterministic and complete stochastic switching; $\underline{T}$ depends on term structure, utility, and time preference.
		A1, B2, C1, D1, E1, F1 or F2, G1, H2, I2, J1, K1, L1 and L2

Source: Horneff, Maurer, Mitchell & Dus, 2008.

As shown in Table 3.2, only three of the prior studies were conducted under a risk-return framework (A2), while 18 of the prior studies used a utility-based framework (A1). In Section 3.1 the studies using a risk-return based framework are presented. In particular the study by Dus, Maurer and Mitchell (2005) is discussed in depth. In Section 3.2 results of some of the prior studies conducted under a utility framework are presented. Results of studies not included in Table 3.2 are also discussed, as well as the study by Milevsky and Young (2007) (see Table 3.2), where neither a risk-return or utility framework was used. In particular the study by Horneff *et al.* (2008) is discussed in greater depth.

Goemans and Ncube delivered a paper called, "Optimal Annuity Strategies after Retirement" at the South African Actuarial Convention in 2008. This paper was the first attempt at comparing South African annuity options at retirement. The findings of their study, which was conducted under a risk-return based framework, are discussed in depth in Section 3.3. In Section 3.4 a follow-up South African study presented at the Actuarial Society of South Africa's 2012 Convention by Lodhia and Swanepoel is discussed, where living and life annuities are compared.

3.2 International evidence on comparing annuities under a risk-return framework

The studies conducted under a utility framework work from the assumption that all individuals will rationally seek to maximise utility among uncertain or risky circumstances. Unfortunately, most individuals are not able to describe their utility-based preferences among uncertain circumstances very clearly and therefore their utility functions remain unknown. Furthermore, recent studies have demonstrated that people do not behave according to their utility maximising frameworks (Milevsky, 1998). The studies in this section were therefore conducted under a risk-value framework.

Milevsky (1998) developed a simulation model based on Canadian data, which deviates from the traditional financial economic utility maximising approach by focusing on the probability of consumption shortfall as the measure of risk. He demonstrated that a 65-year-old male has an 85% chance of being able to beat the rate of return from a life annuity until age 80. Those who consider a 15% probability of consumption shortfall too risky may, however, choose to fully annuitise immediately after retirement. In Canada, most holders of registered retirement savings products (RRSPs) roll their funds over to registered retirement income funds (RRIFs) which require a minimal annual withdrawal as from age 71. No mandatory annuitisation rules are currently in place (TaxTips.ca, 2011).

Dus *et al.* (2005) compared various phased withdrawal strategies to a real life annuity (i.e. an annuity indexed by inflation) benchmark under a risk-return framework for a male aged 65, by doing a simulation on German data. The authors extended their comparison to the USA as well.

Their work extends prior research done in this field, by firstly measuring risk not only as the probability of a loss occurring, but by also taking into account the size of such a loss compared to a real life annuity benchmark. Secondly, they focused both on phased withdrawal plans with fixed benefits, as well as on phased withdrawal plans with variable benefit patterns.

The return measure in their risk-return model represents the expected level of benefits paid out during the retiree's lifetime, as well as the expected bequest. They also examined how the results could change should a mandatory annuitisation rule be followed.

Mandatory annuitisation applies to Germany's "Riester" plans, which offer tax incentives if a portion of the underlying assets is annuitised from age 85 onwards. In the USA annuitisation is not compulsory for 401(k) plans. Most retirees roll their funds over to an individual retirement account (IRA) and manage the funds themselves, subject to the tax laws requiring minimum

withdrawals beginning at age 70.5. In the USA, compulsory annuitisation was recommended by the Commission to Strengthen Social Security. Interestingly, due to UK pension fund reforms, a portion of accumulated pension assets had to be mandatorily annuitised by age 75. This legislation was scrapped in 2006 (Samie, 2011).

In the first withdrawal strategy proposed by Dus *et al.* (2005), i.e. the fixed benefit rule, the retiree will sell as many fund units as required to reach the same yearly benefits B paid by a real life annuity as shown in Formula 3.1. The retiree receives a constant real benefit,

$$B_t = \min(B, V_t). \qquad \text{(Formula 3.1)}$$

where V_t denotes the value of the retirement wealth at the beginning of year t immediately prior to the payment in year t.

The risk of this strategy is that poor investment returns could exhaust retirement assets while the retiree is still alive.

The next three withdrawal strategies allow for variable benefits.

In the fixed percentage rule, determined by Formula 3.2, the retiree receives a fixed fraction of the retirement assets remaining after each period, so that the withdrawal fraction (denoted by w) remains constant, that is,

$$\frac{B_t}{V_t} = w_t = w. \qquad \text{(Formula 3.2)}$$

In the $1/T$ rule the withdrawal fraction is determined by the number of periods that the annuitant is expected to live; more precisely, T equals the oldest age appearing in the applicable mortality table. The withdrawal fraction at the beginning of year t ($t = (0, 1, \ldots, T-1)$ is given by the Formula 3.3:

$$\frac{B_t}{V_t} = w_t = \frac{1}{T-t}. \qquad \text{(Formula 3.3)}$$

Consequently, the retiree gets a fraction equal to $1/T$ of his initial retirement assets as the first payment, and a fraction equal to $1/(T-1)$ of the remaining assets as his second payment, and so forth. The withdrawal fraction increases with age.

In the $1/E(T)$ rule, the retiree's remaining life expectancy for each period is taken into account. For a retiree aged x years, the withdrawal fraction in period t, which is conditional on his survival, is given by the Formula 3.4:

$$\frac{B_t}{V_t} = w_t = \frac{1}{E[T(x+t)]}. \qquad \text{(Formula 3.4)}$$

The shorter the retiree's expected lifetime, the higher the withdrawal fraction. This rule is used in the USA during compulsory decumulation of 401(k) plans from age 70.5.

Several conclusions could be drawn from their model as shown in Table 3.3.

Table 3.3: Comparing results of phased withdrawal strategies with a real life annuity benchmark

Strategy	EPV shortfall	EPV benefits	EPV bequest	Investment weights (in %)	
				Equity	Bonds
A. Results for male (retirement age 65): benchmark real life annuity €5.82 p.a./€100					
1. Real annuity €5.82	0	97.291	0		
2. Fixed benefit = €5.82	3.236	93.867	54.670	25	75
3. Fixed pct. = 5.82%	11.611	95.969	70.218	34	66
4. Fixed pct. Opt $\omega = 7.0\%$	10.366	102.433	56.250	35	65
5. $1/T$ rule age 110	33.726	92.696	154.583	59	41
6. $1/T$ rule opt. age 87	15.003	107.258	33.857	16	84
7. $1/E(T)$ rule	7.797	105.400	40.924	22	78
B. Results for female (retirement age 65): benchmark real life annuity €5.02 p.a./€100					
8. Real annuity €5.02	0	97.291	0		
9. Fixed benefit = €5.02	8.447	101.044	73.378	27	73
10. Fixed pct. = 5.02%	1.334	95.868	62.389	20	80
11. Fixed pct. Opt $\omega = 6.1\%$	7.134	108.465	57.482	28	72
12. $1/T$ rule age 110	25.601	106.508	137.088	46	54
13. $1/T$ rule opt. age 91	12.130	120.062	33.225	16	84
14. $1/E(T)$ rule	5.375	116.899	36.903	19	81

Note that "EPV shortfall" represents the expected present value of future benefit payments below the life annuity; "EPV benefits" represent the expected present value of future benefit payments; and "EPV bequest" represents the present value of future bequest payments.

"Investment weights" represent the asset mix for all the withdrawal strategies minimising EPV shortfall.

Source: Dus, Maurer & Mitchell, 2005.

The fixed benefit rule (row 2), which sets the annuity equal to the life annuity benchmark, exposes the retiree to the risk of outliving his assets while he is still alive. Unless the retiree has a bequest motive, annuitisation (row 1) is far superior to taking a fixed benefit.

The fixed percentage rule (row 3), which pays out a first year benefit equal to the life annuity benchmark, avoids the risk of running out of money. For this strategy the expected shortfall is almost four times as large as under the fixed benefit rule, in exchange for a slightly higher expected benefit and bequest.

The $1/T$ rule (row 5), which determines the withdrawal fraction according to the maximum duration of the payout phase, proved to be inferior to all the other strategies, as the size of the expected shortfall was the largest of those considered, whereas the expected benefits were the lowest of those considered. Only the annuitant's heirs could possibly gain from this phased withdrawal rule.

The $1/E(T)$ rule (row 7), which takes into account the retiree's remaining life expectancy, on its own is appealing because it offers a relatively low expected shortfall risk, as well as 8% higher expected benefits than the real life annuity, together with some bequest potential for heirs.

Considering all the phased withdrawal plans, there is no clearly dominant strategy, as all the strategies involve tradeoffs between risk, benefits and bequests. However, the $1/E(T)$ rule seems relatively appealing as compared to the others, as long as the retiree only has a moderate appetite for bequests.

Interestingly the better strategies in terms of "EPV benefits" resulted in very low equity exposure.

In terms of the switching strategies under consideration, if at the annuitant's mandatory switching age, the remaining funds in his phased withdrawal account are inadequate, the difference represents a shortfall. On the contrary, if the remaining funds in his phased withdrawal account are more than is needed to purchase the benchmark real life annuity, this excess represents a bequest.

Table 3.4: Comparing results of phased withdrawal strategies allowing switching to life annuities with a life annuity benchmark

Strategy	**EPV shortfall**	**EPV benefits**	**EPV bequest**	**Investment weights (in %)**	
				Equity	**Bonds**
A. Results for male (retirement age 65 switching age 75)): benchmark real life annuity €5.82 p.a./€100					
Real annuity €5.82	0	97.291	0		
Fixed benefit until 75	1.411	108.883	13.779	15	85
Fixed pct. Opt $\omega = 6.8\%$	2.856	109.434	13.019	12	88
$1/T$ Rule opt. age 83	3.059	109.360	13.264	11	89
$1/E(T)$ rule	3.582	109.176	13.776	11	89
B. Results for male (retirement age 65 switching age 85): benchmark real life annuity €5.82 p.a./€100					
Real annuity €5.82	0	97.291	0		
Fixed benefit until 85	2.580	104.590	39.988	30	70
Fixed pct. Opt $\omega = 7.4\%$	6.831	110.559	32.727	26	74
$1/T$ rule opt age 88	9.145	110.123	35.703	21	79
$1/E(T)$ rule	5.058	106.616	31.935	16	84

Source: Dus, Maurer & Mitchell, 2005.

Dus *et al.* (2005) found that delaying annuitisation until age 75 overall increases the value of the benefits and shrinks the shortfall, as shown in Table 3.4. However, the potential for bequests decreases, indicating that the deferred annuitisation strategy is likely to be most appealing to retirees who wish to maximise payouts while alive. Purchasing the annuity at an even later age (85), promises more bequest potential at the cost of a higher shortfall during the annuitant's lifetime.

Table 3.5: Comparing results of phased withdrawal strategies and immediate purchase of mandatory deferred life annuities with a life annuity benchmark

Strategy	EPV shortfall	EPV benefits	EPV bequest	Investment weights (in %)	
				Equity	Bonds
A. Results for male (retirement age 65 annuity deferred up to age 75): benchmark real life annuity €5.82 p.a./€100					
Real annuity €5.82	0	97.291	0		
Fixed benefit until 75	1.050	100.712	4.200	10	90
Fixed pct. Opt $\omega = 15.3\%$	8.954	108.664	8.944	55	45
$1/T$ rule opt. age 74	1.469	102.390	3.710	8	92
$1/E(T)$ rule	21.291	128.127	34.783	89	11
B. Results for male (retirement age 65 annuity deferred up to age 85): benchmark life annuity €5.82 p.a./€100					
Real annuity €5.82	0	97.291	0		
Fixed bench until 85	1.771	101.730	27.606	20	80
Fixed pct. Opt $\omega = 8.7\%$	10.291	107.818	36.586	39	61
$1/T$ rule opt age 85	6.917	108.891	21.820	17	83
$1/E(T)$ rule	10.166	105.603	35.704	25	75

Source: Dus, Maurer & Mitchell, 2005.

When the phased withdrawal strategies are combined with a mandatory deferred life annuity with annuity payments starting at age 75 or 85 respectively, assuming the retiree is alive, the $1/E(T)$ rule becomes less appealing, as is evident from Table 3.5. On the other hand, the 1/T, fixed percentage and fixed benefit rules have appealing risk characteristics when combined with deferred life annuities. This unfortunately comes with very low expected bequests.

Overall results are similar for the USA case.

Milevsky, Moore and Young (2006) found a definite advantage of including a life annuity in a retiree's portfolio in order to reduce the probability of "lifetime ruin", which is defined as the probability that a fixed consumption strategy will lead to zero wealth while the retiree is still alive. Optimal investment in equities increased with wealth, whilst under other assumptions it decreased.

3.3 International evidence on comparing annuities under a utility framework

Yaari (1965) showed that retirees without a bequest motive and an unknown date of death should annuitise all their wealth if life annuities available for purchase are actuarially fair. His theory further rests on the assumption that retirees are Von Neumann-Morgenstern expected utility maximisers with intertemporally separable utility. Research by Davidoff, Brown and Diamond (2005) extended Yaari's (1965) research, by relaxing some of his restrictive assumptions, including that markets need not be actuarially fair and that retirees need not be Von

Neumann-Morgenstern expected utility maximisers with intertemporally separable utility. They similarly predicted full annuitisation under Arrow-Debreu market completeness and no bequest motive. The authors further predicted that even under market incompleteness, and allowing for a bequest motive, a large portion of wealth is optimally annuitised. Similarly, Kapur and Orszag (1999) determined, by considering the pay-out phase of a defined contribution fund by means of stochastic optimal control, that a retiree invested in life annuities and equities will eventually completely annuitise.

Milevsky and Young (2002; 2003) used the models of continuous-time financial economics introduced by Merton (1969; 1971) and later extended by Richard (1975) under constant relative risk aversion (CRRA), to illustrate the value of delaying annuitisation in the absence of bequest motives, and subsequently derived the optimal age of 70 at which a retiree should fully annuitise. This is referred to as the real option to delay annuitisation (or RODA). In addition they established the optimal annuity purchasing policy for a retiree who can purchase life annuities on an ongoing basis. They found that individuals should immediately annuitise a fraction of their wealth at retirement, even in the presence of a bequest motive, to create a base level of lifetime income. Subsequently they should purchase more life annuities as their wealth-to-income ratio exceeds a certain level.

Babbel and Merrill (2006) also developed a continuous time model in the spirit of Merton (1969, 1971) and Richard (1975) and concluded that high levels of annuitisation are rational under a wide range of risk aversion levels.

Blake, Cairns and Dowd (2003) found that, in the absence of a bequest motive, the optimal annuitisation age is 79 for the very low relative risk averse (RRA) investor. On the contrary, for the highly risk averse, the appropriate option will be full annuitisation at retirement. This is consistent with Merton (1983) who analysed the pension system in the USA. Blake *et al.* (2003) also found that in the presence of a bequest motive, retirees are inclined toward annuitising at an even later age. This is echoed by Kingston and Thorp (2005) who built on Milevsky and Young's (2002; 2003) analysis under a generalised logarithmic utility model (GLUM) with no bequest motive. They found that under their model there is an incentive to annuitise earlier compared to Milevsky and Young's (2002; 2003) findings, and that putting off full annuitisation will be better for the more risk tolerant.

In the study by Gerrard, Haberman, and Vigna (2004) annuitisation is deffered until the age of 75. They consider the optimal investment allocation for an income drawdown plan, until annuitisation occurs at age 75. They compared the deferred approach with complete annuitisation at retirement. Their main result is that for a pensioner with low risk aversion, annuitisaton should optimally be deferred.

Milevsky and Young (2007) used preference-free dominance arguments to develop a framework for attaining the optimal age at which to annuitise, based on USA equity markets. They found that annuitisation prior to the age of 65 to 70 is inferior to a self-annuitisation strategy, even if no bequest motive is present. For retirees willing to accept a minimal level of risk, annuitisation can be delayed even further.

Charupat and Milevsky (2002) demonstrated the optimal utility maximising asset allocation between a risky (i.e. a variable immediate annuity) and risk-free asset (i.e. a fixed immediate annuity), within a variable annuity contract assuming that the entire retirement payout is annui-

tised. In the USA a variable annuity contract is a savings and decumulation investment product. Under CRRA preferences and geometric Brownian motion (GBM) dynamics, the optimal asset mix during the annuity pay-out phase is the same as during the savings accumulation phase. This is consistent with the Merton (1971) solution.

Koijen, Nijman and Werker (2006) suggested that annuitisation exposes the retiree to annuity risk, which is defined as the risk of an unfavourable annuity rate at retirement. They determined the optimal allocation of nominal, inflation-linked and variable annuities, conditional on the state of the economy. They also showed that it is possible to mitigate annuity risk at retirement, by investing in certain asset classes in the accumulation phase.

In the case of the study conducted by Horneff, Maurer and Stamos (2008a), gradual annuitisation starts before retirement. In the gradual switching case the retiree is not restricted in terms of switching opportunities. In the case without bequest motives, life annuity demand increases with age, i.e. the age effect. The demand for life annuities also increases with levels of wealth on hand, i.e. the wealth effect. They found it to be optimal for households to invest partially in annuities during their working life, and to continue shifting wealth to annuities. Every utility maximising household started to annuitise before 70. Full annuitisation occured prior to 85, except where a bequest motive was present. Even where a bequest motive was present, the annuity fraction made up 65% of total retirement assets.

Horneff, Maurer and Stamos (2008b) included partial and gradual switching strategies in their study. In the partial switching case the investor has one opportunity to purchase life annuities with a fraction of his retirement assets. They found that full and partial switching strategies do not only cause annuitisation to be deferred, but they can also reduce annuitisation. In the gradual switching case, the utility maximising retiree starts to purchase annuities at retirement with 30% of his retirement assets. After retirement he continues to purchase annuities until full annuitisation is reached at 78, unless there is a bequest motive, in which case full annuitisation never occurs.

In an effort to compare a constant life annuity with phased withdrawals (see the discussion in Dus *et al.* (2005) in Section 3.1 above), and a combination of the two, Horneff *et al.* (2008) simulated USA data under a utility framework with no bequest motive, thereby enabling them to also demonstrate the welfare implications of making annuitisation compulsory at a specific age. They considered the case for a female aged 65.

Their results, indicating the equivalent annuity streams for alternative phased withdrawal rules, as shown in Figure 3.1, are based on a range of risk aversion coefficients, as measured by ρ from 1 (low risk aversion) to 10 (high risk aversion) according to Table 3.6.

Table 3.6: Risk aversion levels

Risk aversion	ρ
Low	< 1
Moderate	$1 - 5$
High	> 5

Source: Horneff, Maurer, Mitchell & Dus, 2008.

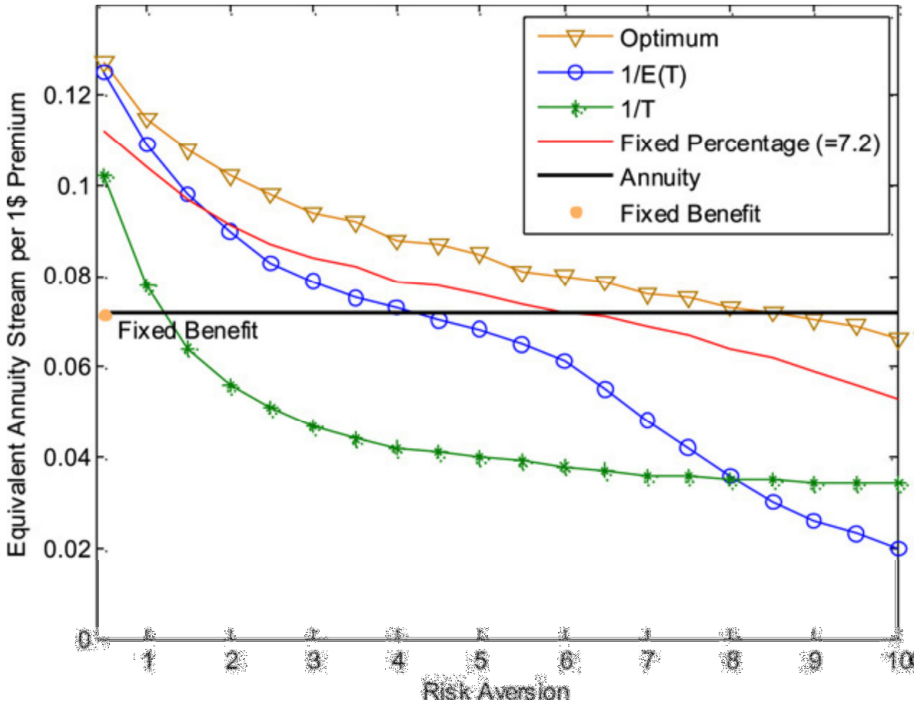

Figure 3.1: Equivalent annuity streams for alternative phased withdrawal rules

Source: Horneff, Maurer, Mitchell & Dus, 2008.

The $1/E(T)$ rule dominated all payout rules for risk preferring individuals, followed by the fixed percentage rule. The $1/T$ rule dominated the constant life annuity and fixed benefit rule for individuals with an extremely low risk aversion.

The fixed percentage rule dominated all payout rules for the moderate risk averse, followed by the $1/E(T)$ rule. The constant life annuity was preferred next, followed by the $1/T$ rule. It can be concluded that phased withdrawal rules, except for the $1/T$ rule, are superior to the constant life annuity for low to moderate risk averse individuals as the retiree can gain by investing in the capital market and from betting that they will not live long.

The constant life annuity dominated all payout strategies for the extremely risk averse. This is consistent with previous studies, which show that annuities are attractive as a stand-alone product when the retiree is extremely risk averse and does not have a bequest motive. The constant life annuity was followed by the fixed percentage rule. The $1/T$ came in third place, and the $1/E(T)$ rule was the least preferred by those with a high risk aversion.

To summarise, the fixed benefit rule was dominated by all the other phased withdrawal strategies and the life annuity, as it exposes retirees to the risk of outliving their assets.

The $1/T$ performed worse than any other variable withdrawal rule for a broad range of investors.

Comparing the withdrawal rules, the authors found that the fixed percentage rule is preferred by retirees across a wide range of risk preferences. It dominated the $1/T$ rule across all risk preferences, and it was superior to the life annuity for low to moderate risk aversion levels.

The $1/E(T)$ rule appealed to low to moderately risk averse retirees, but proved to be the least preferred rule to follow for the very risk averse.

Figure 3.2 shows the optimal asset allocation associated for alternative distribution rules. For risk aversion values of up to two, the retiree holds all of his assets in equities, where as if the retiree's risk aversion increases, the optimal exposure to equity falls.

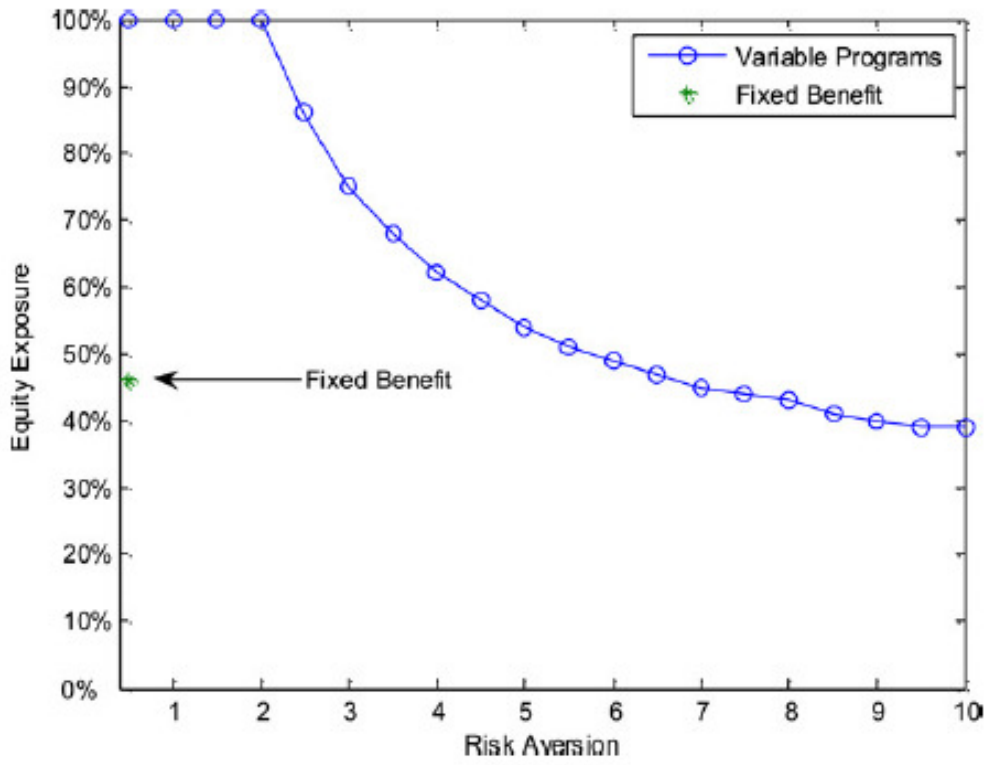

Figure 3.2: The optimal asset allocation for alternative distribution rules

Source: Horneff, Maurer, Mitchell & Dus, 2008.

The authors furthermore found that an initial blending strategy, where a life annuity is combined with a phased withdrawal plan works well for retirees with moderate to high risk aversion, since the annuity portion of the investor's income is guaranteed. It can also enhance the benefits that investors receive, by having exposure to the capital market. Individuals with low risk aversion will not invest in a constant life annuity. They found that a retiree with moderate aversion to risk is likely to invest approximately 60% of her wealth in annuities and 40% in a phased withdrawal plan as shown in Figure 3.3.

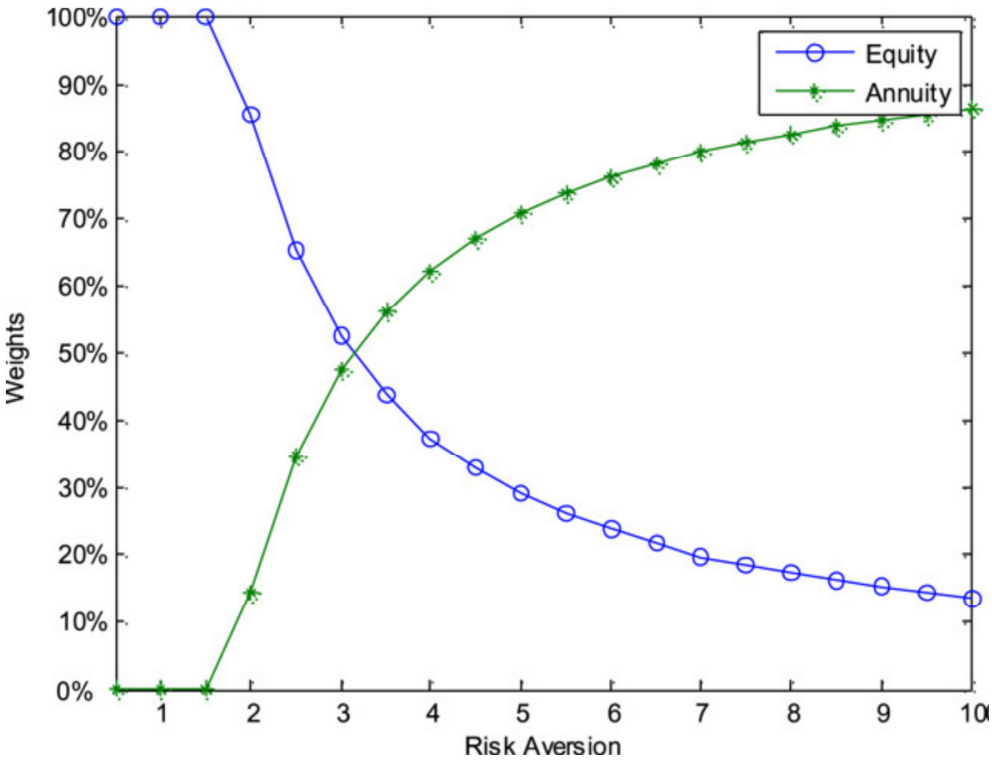

Figure 3.3: Optimal blend of a phased withdrawal strategy with a life annuity for different risk aversion levels

Source: Horneff, Maurer, Mitchell & Dus, 2008.

They also concluded that less risk averse retirees will probably wait longer until they switch to a life annuity as higher interest rates are required to induce annuitisation amongst retirees, whereas very risk averse individuals are usually willing to annuitise in a lower interest rate environment as shown in Figure 3.4.

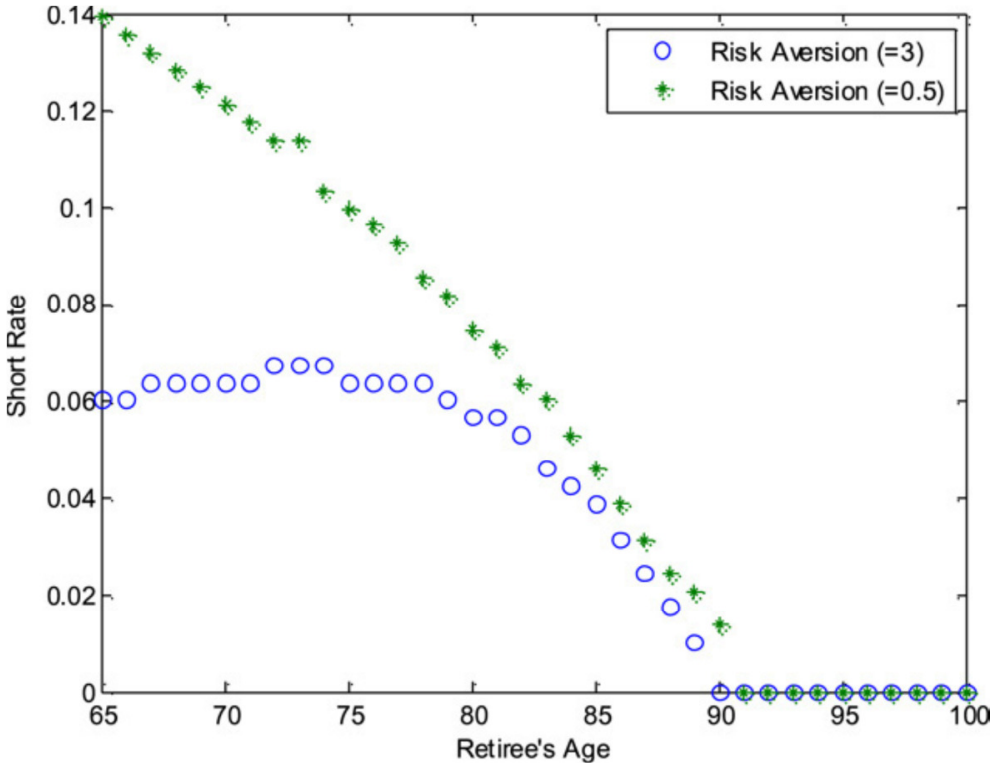

Figure 3.4: Rate at which retiree will switch to a life annuity for different risk aversion levels

Source: Horneff, Maurer, Mitchell & Dus, 2008.

The authors also came to the conclusion that retirees with a risk aversion coefficient (ρ) of 4.5 or higher are likely to annuitise immediately after retirement, whereas individuals with a risk aversion coefficient of 3 will postpone switching to a constant life annuity until age 80. Their results further show that switching to a constant life annuity later in retirement is more beneficial to risk preferring retirees.

Finally, their results show that those retirees with moderate to high risk aversion benefit more from investing in a combination of a life annuity and a phased withdrawal plan initially at retirement, compared to a strategy where the retiree only annuitises at a later stage. These findings are illustrated in Table 3.7. The last two rows compare the gains in equivalent annuity streams from a switching (row 2) and initial blending (row 3) strategy respectively to that from undertaking immediate complete annuitisation at age 65.

Table 3.7: Percentage increase in equivalent annuity stream for blended strategies

	Risk aversion (ρ)									
	0.5	1	2	2.5	3	3.5	4	4.5	5	10
Switching age	85	84	82	81	80	77	75	65	65	65
Switching (deferring) vs. full annuitisation at 65	77.67	54.81	26.1	17.32	10.98	6.21	2.46	0	0	0
Immediate blending vs. full annuitisation at 65	74.02	52.36	25.17	18.79	14.93	12.36	10.52	9.18	8.13	3.79

Source: Source: Horneff, Maurer, Mitchell & Dus, 2008.

3.4 South African evidence on comparing annuities under a risk-return framework

Goemans and Ncube (2008) analysed which of the main annuity types in South Africa were expected to provide the highest future lifetime income to a 60-year-old male retiring with R500 000 on 31 December 2007 until age 90, by simulating 1000 scenarios.

They considered the risk and return characteristics of each annuity type. Risk refers to the probability of ruin, and is defined as the likelihood of not meeting specific income levels or benchmarks. Return refers to the expected present value of future income received.

Two guaranteed life annuities were considered, namely a level life annuity and a life annuity increasing by 5% every year, as well as one partially guaranteed life annuity, namely a with-profits annuity. A ten-year guaranteed term for the three life annuities applied. In addition, three living annuity drawdown strategies, with seven initial drawdown rates starting from the minimum of 2.5% through to the maximum of 17.5% in increments of 2.5%, and five different asset allocations ranging from very aggressive to very conservative, were considered.

Remaining capital at death with respect to living annuities was not taken into account, as only cash flows received during the annuitant's lifetime applied. Finally, the authors researched whether it is beneficial to switch from a living annuity to a guaranteed life annuity at later stages in retirement.

Expectedly, they found that in order to obtain the maximum expected income from a living annuity, the investor should follow an aggressive investment strategy and withdraw the maximum allowable income annually. Unfortunately, this option will result in a quickly decreasing cash flow pattern. Varying the drawdown rate over time helped in increasing the chance of obtaining the desired income pattern.

Moreover, the conclusion was made that if the retiree under investigation wishes to have a high probability of maintaining his initial income, the initial drawdown rate should not be more than 7.5%. If growth of income is required, the initial drawdown rate should be reduced to

2.5% or 5%, depending on risk preference. In terms of asset allocation it seems that a more conservative investment portfolio is optimal, with 25% of the underlying investment capital invested in equities.

The authors found that the two guaranteed life annuities, namely the level life annuity and the life annuity increasing with 5% every year, as well as the with-profits annuities, were far superior to the living annuity strategies, on a risk-value basis.

The authors furthermore concluded that living annuitants will only be able to obtain a level of income comparable to that of a guaranteed life or with-profits annuity, if they are willing to tolerate a decreasing income stream. This will most likely not be the case, as retirees usually wish to earn income that keeps pace with the inflation rate.

What is not clear is which of the with-profits or the guaranteed life annuities performed best. With-profits annuities are expected to provide more expected future lifetime income than guaranteed life annuities, but this option comes with greater risk. The eventual choice comes down to an individual's risk preference, as well as the inflationary environment.

Although not taken into consideration in this study, the with-profits annuity should be able to offer, in times of high inflation, a greater degree of inflation protection than a guaranteed annuity. Inflation-linked annuities also provide inflation protection, but this option comes with very low initial income levels. In a high inflation environment, level life annuities should not even be considered as they are certain to provide a decreasing real income stream to the retiree, despite the high initial income levels it offers.

Switching from a living annuity to a life annuity adds value to the retiree, by increasing the expected value of future lifetime income, and by decreasing the probability of ruin. In order to derive the most benefit, the authors found that such switching should occur at age 70. The results, however, still suggested that as a result of decreasing interest rates in the economy, the annuitant would have been better off by not delaying annuitisation and locking into a guaranteed life annuity at retirement.

3.5 South African evidence on living annuities and guaranteed life annuities to provide a minimum real income for life

Lodhia and Swanepoel (2012) believe that the sales of living annuities have been driven by incentive structures and a lack of insight into the product's design, which in turn poses a threat to pensioners, as they may face destitution in retirement, and the government, as they will have to provide alternative support to destitute pensioners, and the financial industry as a whole, as they may be accused of wrongful selling.

The main purpose of their study was to evaluate the ability of a living annuity to provide a minimum real income for life, and to compare this to the income provided by an inflation-linked guaranteed life annuity.

Their study focused on a retired male, aged 65 years without dependants and in good health,

retiring with R1 million. In their modeling a nominal interest rate of 8% was used, an inflation rate of 5.5% and a real return of 2.5%. Costs were ignored. The guaranteed life annuity excluded joint options and guarantee periods. Living annuity drawdown rates were set to provide income equal to the guaranteed annuity, except where this was not possible due to the 17.5% cap placed on living annuity withdrawal rates.

They argued that retirees overestimate their ability to outperform a guaranteed annuity, because with a guaranteed annuity, both longevity (i.e. outliving one's capital) and investment risk are transferred to the insurer, and these benefits should not be overlooked.

The authors put forward that to purchase a living annuity implies that one chooses not to insure the risk of outliving one's capital. They further postulated that a retiree has a 50% chance of living longer than the average life expectancy. The failure of retirees to insure this risk does not coincide with their risk aversion levels. This could only be explained, according to Lodhia and Swanepoel (2012) by their misunderstanding of the product, or their overconfidence in their ability to outperform a guaranteed annuity.

In addition, they came to the conclusion that it is better to annuitise at age 65 as opposed to postponing it until a later age, as the value lies in capturing the mortality credits early on. Their research further suggests that it is unlikely for a retiree to have the capital required at, for example, 75 years of age to purchase the income he would have been receiving if he had bought the guaranteed annuity at retirement.

If a member should therefore choose to defer annuitisation by 10 years, he would need to earn an additional 3% in investment returns each year between the ages of 65 and 75, or purchase a living annuity at 65 that would provide an income 32% lower than the guaranteed annuity, or start with capital of R1.2 million rather than the R1 million used to purchase the guaranteed annuity, or see real interest rates increase from 2.5% to 13.2%, or a combination of all of the above. This is illustrated in Figure 3.5.

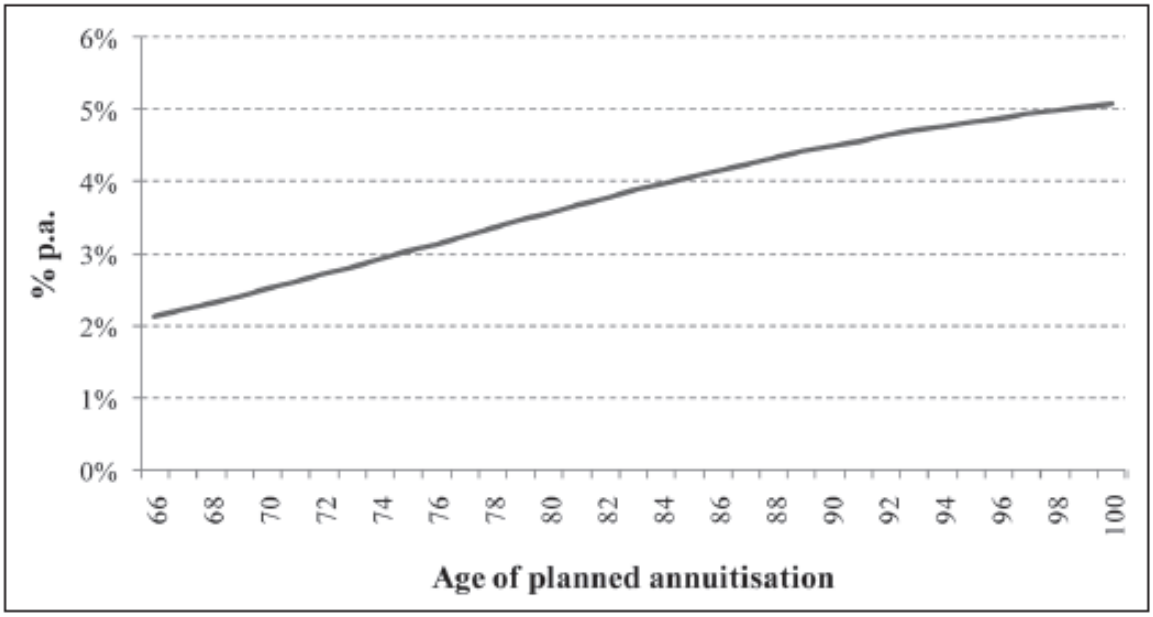

Figure 3.5: Annual living annuity investment outperformance required during deferment to break even at different ages

Source: Lodhia and Swanepoel, 2012.

They found that since a guaranteed annuity has no cap, and benefits from mortality pooling (where members living for a short period after retirement, subsidise those living longer), their income stream is more attractive than what a living annuity can provide. They found that a living annuity will need to deliver CPI + 5.5% for the average member in a living annuity who survives for ten years after retirement in order to break even with a guaranteed annuity. Over the very long term, equities have returned investment growth of CPI+7%, but with correspondingly high levels of volatility, which they argue the average retiree cannot afford to bear.

Many people are drawn to living annuities as it preserves remaining capital at death (a.k.a. the sum insured). According to Lodhia and Swanepoel (2012) this sum insured decreases in both nominal and real terms, as capital is drawn down to fund retirement spending. They suggest that a member's bequest motive can be more suitably addressed by purchasing separate life insurance cover. They further add that life cover increasing with inflation could even be considered, but warn that it might be very expensive to insure one's life at such a mature age.

Lodhia and Swanepoel (2012) showed that a member can expect to recoup all of his capital investment and returns thereon within the first 15 years of a guaranteed annuity which is assumed to be at age 80 (given the assumed retirement age of 65). This is illustrated in Figure 3.6.

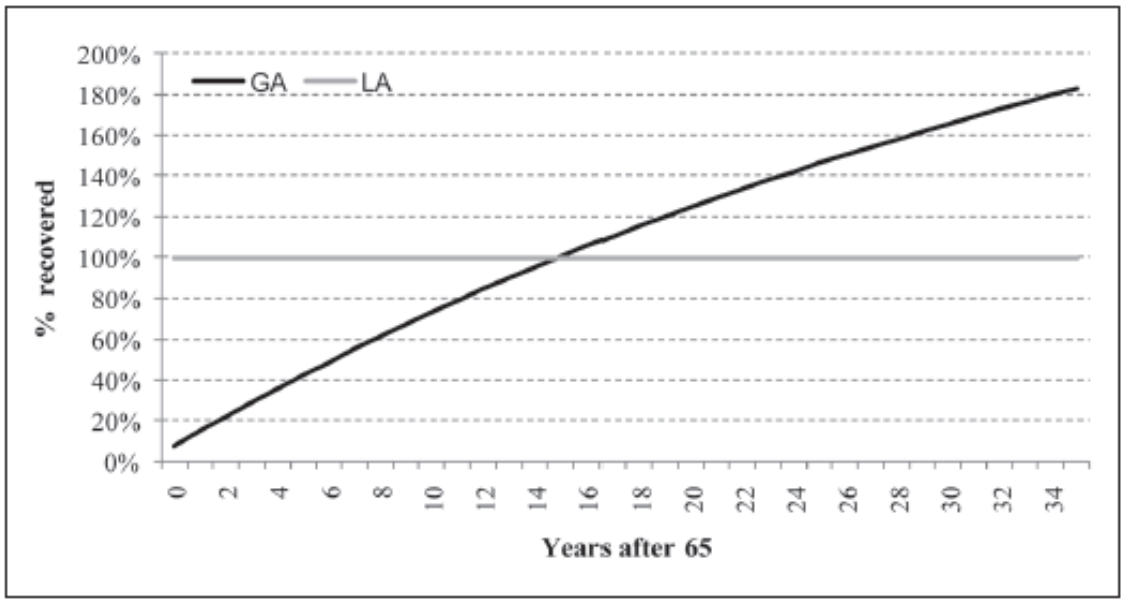

Figure 3.6: Percentage of capital recovered from a living annuity and a guaranteed annuity at each age

Source: Lodhia & Swanepoel, 2012.

It can also be concluded from Figure 3.6 that surviving beyond 80 years of age poses problems for members invested in a living annuity.

They concluded that although a guaranteed annuity is better equipped to provide a real income for life, living annuities remain a suitable choice for the unhealthy and so-called impaired lives, who expect to die soon after retirement, as well as for very wealthy retirees with alternative sources of retirement income. They reiterated that low savings rates in SA imply that most retirees are dependent on their retirement savings for post-retirement income.

They found that the cap placed on living annuities does in fact preserve capital, but at the expense of an adequate income stream at retirement comparable to the guaranteed annuity. Once members reached the cap, they experienced a reduction in retirement income, unless of course a net investment return of more than 17.5% was earned. This is illustrated in Figure 3.7.

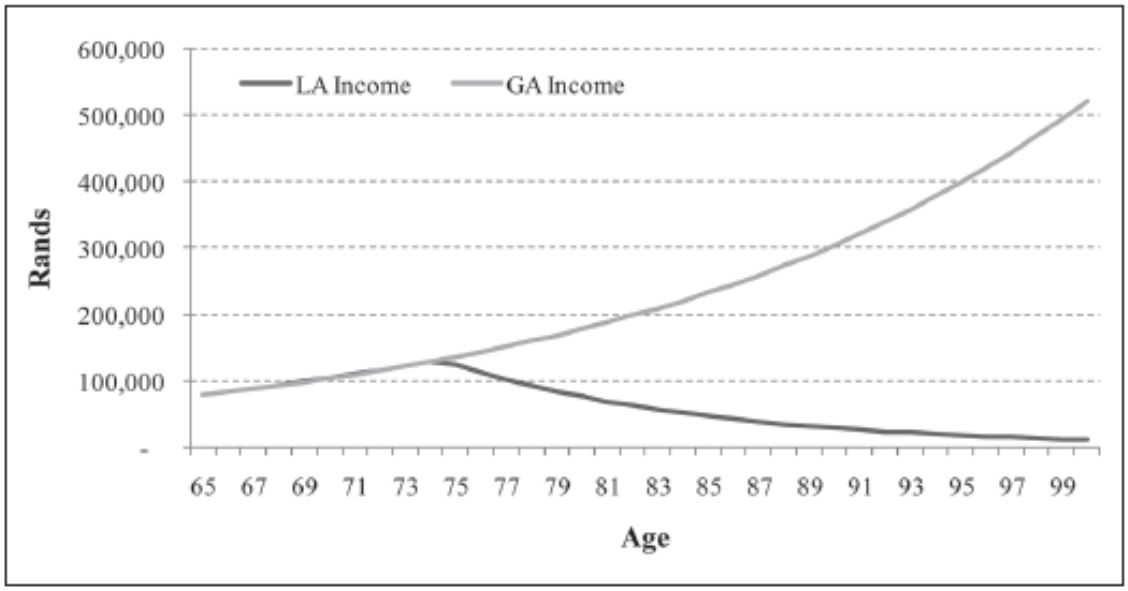

Figure 3.7: Annual living annuity versus guaranteed annuity by age

Source: Lodhia & Swanepoel, 2012.

It is evident from the graph in Figure 3.7 that for the same upfront investment and the same net investment returns, the guaranteed annuity is able to provide a better income stream than the living annuity. It further supports the notion that members who live longer than expected recoup more than 100% of their initial investment, whereas the maximum recouped from a living annuity is 100% of the initial investment.

Chapter 4

Methodology

4.1 Data collection

The main objective of this study is to establish, for the 30-year period 1960 to 1989, which of several specific annuity strategies provided the largest financial benefit in present value terms to retiring males aged 55, 60 and 65 respectively. In order to calculate the annuity payments provided by the various living, life, composite and switching annuity strategies, bond and equity market data were required, as well as life annuity rates. In addition, inflation data was required in order to discount annuity payments to a present value as at retirement. The sources of the data gathered, as well as a description thereof, are presented in Section 4.1.1 to Section 4.1.4.

4.1.1 Bond data

The bond market data gathered is divided into four subsections.

4.1.1.1 Data from 1960 to 1979

As the Johannesburg Stock Exchange (JSE) Actuaries Fixed Interest Index was only launched in the 1980s, a theoretical 20-year bond was used to measure historical performance from 1960 to 1979, as developed by Firer and McLeod (1999). As yields changed during this period, the performance from holding this one-bond portfolio was affected. The coupon level was revised whenever a long-dated government bond was issued, effectively changing the bond in die portfolio (Firer & McLeod, 1999: 22). The methodology of the JSE-Actuaries Fixed Interest Performance Index, one of the component indices introduced by the JSE and the Actuarial Society of South Africa (ASSA) in 1988, was used to chain-link the index when the constituent bond changed. This approach resulted in monthly figures for the price index and interest yield. The interest yield is analogous to the dividend yield for equities. As with the dividend yield for equities, the calculation of the interest yield is based on the assumption that 1/12 of the interest income is earned in each month.

4.1.1.2 Data from 1980 to 1985

The JSE-Actuaries Fixed Interest Index was launched in January 1983 with historical data from 1980 to 1985. It comprised of price indices and an income index for two classes of gilt and semi-gilt stocks, which were further subdivided into four term sub-indices. No attempt was made to calculate an overall index, which resulted in the index not being widely accepted by market participants (JSE, 2000: 6). In order to calculate the equivalent of an All Bond Index (ALBI), a different methodology was used to measure historical performance for the period 1980 to 1985, as developed by Firer and McLeod (1999).

The performance of component indices, with terms to maturity of zero to three years, three to seven years, seven to 12 years and 12 or more years, was taken from the JSE-Actuaries Bond Index Handbook published in 1988 (Firer & McLeod, 1999). These performances were calculated using weightings of 15%, 20%, 15% and 50% respectively, and were based on market capitalisation information on index components as at January 1986. This approach resulted in overall monthly bond returns.

4.1.1.3 Data from 1986 to 1997

The JSE-Actuaries Fixed Interest Performance Index was introduced by the JSE and ASSA in 1988 in an attempt to improve on the JSE-Actuaries Fixed Interest Index. The JSE-Actuaries Fixed Interest Performance Index, which backdates to 1986, was used to measure historical bond performance from 1986 to 1997. The equal nominal weighting of the JSE-Actuaries Fixed Interest Index was replaced by market capitalisation weighting (Thomson, 2001: 19). The performance of the component indices (with terms to maturity of zero to three years, three to seven years, seven to 12 years and 12 or more years), as was used in the JSE-Actuaries Fixed Interest Index, was retained (Thomson, 2001: 19). This approach resulted in monthly figures for the price index and interest yield.

4.1.1.4 Data from 1998 onwards

The ALBI as developed by the Bond Exchange of South Africa (BESA) and the ASSA in the first half of 2000, was used from 1998 onwards to measure historical performance. It comprises of the top 20 listed bonds, ranked by market capitalisation and liquidity (JSE, 2010: 5). The ALBI comprises of bonds with terms to maturity of one to three years, three to seven years, seven to 12 years and 12 or more years (JSE, 2000: 8). Monthly price index and interest yield data was obtained from the INet-Bridge databasis.

4.1.2 Equity data

The equity market data is divided into two subsections.

4.1.2.1 Data from 1960 to June 2002

The JSE-Actuaries All Share Index was launched at the start of October 1978 with historical data from 1960. It is calculated as the weighted arithmetic average of the prices of the components based on market capitalisation (Firer & McLeod, 1999), and was used to measure historical performance of equities from 1960 to June 2002. The calculation of the dividend yield, i.e. the income portion of the All Share Index, was based on the assumption that 1/12 of the dividend is earned in each month. Both the price index and dividend yield data was obtained from the INet-Bridge databasis.

4.1.2.2 Data from July 2002 onwards

The FTSE/JSE Africa Index Series was a result of a joint venture between the JSE Limited and the FTSE Group. There has been a change in the methodology used to calculate indices as well as in the classification of sectors. There has been a move away from indices based on full market capitalisation to free float adjusted indices. The FTSE/JSE Africa Index Series replaced the JSE Actuaries indices mid June 2002 (FTSE/JSE, 2008: 2), and was used to measure historical performance of equities from July 2002 onwards. Both the price index and dividend yield data was obtained from the INet-Bridge databasis.

4.1.3 Consumer Price Index (CPI) data

The CPI as produced by Statistics South Africa (StatsSA), measures monthly changes in price for a range of consumer products. The monthly inflation rate is the change in the CPI for all consumer products in the relevant month, compared with the CPI for all consumer products in the previous month expressed as a percentage.

The changes to the calculation of the CPI in January 2009 brought South Africa in line with international standards and best practices (StatsSA, 2009: 1). The CPI figures, before and after 2008, were normalised around the same base year in order to link them into one index.

4.1.4 Life annuity rates

Life annuity rates were provided by Sanlam. Sanlam used the a (55) life mortality tables as published by the Cambridge University Press in 1953 (Botha *et al.*, 2011: 1056), as well as government bond rates with a term of 10 years and over, supplied by the South African Reserve Bank (SARB), to calculate life annuity rates. The life annuity rates provided by Sanlam very closely tracked their own rates, of which they have only a limited history.

4.2 Describing the calculations in the spreadsheet

As the purpose of this study is to establish which of various annuity strategies would have been best to follow in the 30 years from 1960 to 1989, the present values of the monthly cash flows provided by:

- Three living annuity strategies,
- Two life annuity strategies,
- A composite annuity strategy, and
- A switching annuity strategy,

were calculated in order to ascertain which strategy provided the largest financial benefit in present value terms.

4.2.1 Living annuity strategies

For male annuitants retiring at the ages of 55, 60 and 65 respectively, during the period 1960 to 1989, the present values of the monthly cash flows provided by the three living annuity drawdown strategies outlined on the next page (see a-c) were calculated, using existing equity and bond market index data with the following assumed asset allocations:

A. A conservative (25% equity; 75% bonds);

B. A moderate (50% equity; 50% bonds); and

C. An aggressive (75% equity; 25% bonds) risk profile.

Throughout the study the different asset allocations are referred to by these symbols A, B and C.

The initial drawdown rates followed the recommendations of the Life Offices Association of South Africa's (LOA) Code on Living Annuities (LOA, 2008), and are given in Table 4.1.

Table 4.1: Indicative life annuity rates

Indicative life annuity rates							
Age	**55**	**60**	**65**	**70**	**75**	**80**	**85**
Male	5.5%	6.2%	7.3%	8.7%	10.7%	13.5%	17.5%
Female	4.8%	5.4%	6.2%	7.3%	8.9%	11.2%	14.6%

Source: LOA, 2008.

Table 4.1 gives an indication of the life annuity rates available to males and females of different ages. It is recommended by the LOA that annuitants invested in living annuities should not withdraw more than the income available under life annuities (LOA, 2008). After the publication of the LOA's Code on Living Annuities, (LOA, 2008), ASISA issued new regulations in terms of initial drawdown rates (ASISA, 2010), but they have not been widely used in practice, as they are not user-friendly (Lodhia & Swanepoel, 2012). Only the initial drawdown rates for males aged 55, 60 and 65 respectively are used in this study.

The monthly annuity payment is calculated by multiplying the monthly withdrawal rate with the end of January market value of the equity and bond portion of the portfolio respectively. This monthly annuity payment stays fixed for the entire year (see numerical example 1 in Table 4.2).

Three living annuity drawdown strategies were considered:

a. Maintaining the same drawdown rate throughout.

b. Adjusting the drawdown rate each year to increase the Rand amount of income by 5% per annum, but staying within the legal limits of between 2.5% and 17.5% of the underlying investment value.

c. Adjusting the drawdown rate each year to increase the Rand amount of income by the annual inflation rate, again remaining within the legal limits.

Throughout the study the different drawdown strategies are referred to by these symbols a, b and c.

Living annuity investments attract a number of costs. The following costs were taken into account in the calculations:

- An underlying base asset management fee including value-added tax (VAT) of 1.4% per annum on the equity portion of the portfolio, and 0.9% per annum on the bond portion of the portfolio;
- An annual adviser's fee of 0.57% including VAT; and
- A Linked Investment Service Provider (LISP) fee of 0.25% per annum on the equity and bond portion of the portfolio respectively.

These rates were obtained by calculating the average fees for five of the largest general equity, and three of the largest bond unit trust funds.

The total living annuity investment costs were deducted from the portfolio at the end of each year, **after** the last annuity payment out of the equity and bond portion of the portfolio was made, and **before** the portfolio had been rebalanced.

The portfolios were rebalanced annually to maintain asset allocations.

The present values of cash flows were calculated per R1 million invested.

Although living annuitites have only been marketed in South Africa since the 1990s, we have assumed for the purposes of this study that they have been in existence since 1960.

The discount rate for a cash flow in month n, is the geometric average of the successive inflation rates through months one to n (see numerical example 1 in Table 4.2).

The above discount rates that applied for each month in a single year were used consistently for the sake of comparability, across all annuity strategies.

The monthly inflation rates (the percentage change in the CPI) from one month to the other were used in this study to discount monthly cash flows, in order to specifically determine the present value of annuity payments received as at retirement date. This discount rate differs from the other key studies discussed in Chapter 3 in the following respects:

Goemans and Ncube (2008) used the starting yield curve to discount future income streams, but pointed out that further research is required into which discount rates are to be used.

Lodhia and Swanepoel (2012) assumed a nominal interest rate of 8% per annum, an inflation rate of 5.5% per annum and a real return of 2.5% per annum in their modelling.

In the study by Dus, Maurer and Mitchell (2005) the interest rate (adjusted for inflation) used to discount annuity payments was set to 1.5% per annum, which is consistent with the current yield of Euro-based inflation-linked bonds (see numerical example 1 in Table 4.2).

It was assumed that the male annuitants (aged 55, 60 and 65) retired every year, at the beginning of that year, during the period 1960 to 1989, and that their life expectancy was that of the a (55) life mortality table as published by the Cambridge University Press in 1953 (Botha *et al.*, 2011: 1056). In terms of section 10A of the Income Tax Act 52 of 1962 (Republic of South Africa, 1962), the a (55) life mortality table (Botha *et al.*, 2011: 1056) is used when calculating the capital element of a voluntary life annuity. According to this mortality table, a male aged 55 has a life expectancy of 21.445 years, a male aged 60 has a life expectancy of 17.520 years and a male aged 65 has a life expectancy of 13.936 years. For the purpose of this study these life expectancies were rounded off to the nearest year. Thus it was assumed that the male aged 55, 60 and 65 had a life expectancy of 21, 18 and 14 years respectively. The remaining capital at death was also discounted to a present value.

As this study is based on historical data available up to December 2010, a sub-period of 30 years was used (1960 to 1989) to ensure that the time period includes the expected date of decease of a male.

For the living annuity strategies, the present values of cash flows for 810 combinations (three drawdown strategies combined with three asset allocations for three retirement ages over 30 years) were calculated (see Appendix A, Table A.1).

In order to explain the layout of the spreadsheet used to do the calculations, a numerical example is now presented. For easy reading, all amounts in the numerical example have been rounded off to the second decimal. No amounts were rounded off in doing the calculations in the spreadsheet.

Table 4.2: Numerical example 1

Background		**F***
Assume a male, aged 55, retires on 1 January 1987 with an investment amount of R1 million		
Date of death *According to the a (55) life mortality tables, this male annuitant has a life expectancy of 21 years, but as the first annuity payment is received at the end of January 1987, the last annuity payment is only received at the end of January 2008.*	31 January 2008	
He invests according to a conservative risk profile	*25% of the investment amount in equity and 75% in bonds*	
Initial annual drawdown rate	5.5% *(see Table 4.1)*	
Annual drawdown rate is maintained throughout	*See drawdown strategy* a *in Section 4.2.1*	
Monthly drawdown rate	$\frac{5.5\%}{12} = 0.46\%$	4.1
Costs		
Asset management fees levied on: Equity portion of portfolio Bond portion of portfolio	 1.4% 0.9%	
Adviser's fee levied on: Equity portion of portfolio Bond portion of portfolio	 0.57% 0.57%	
LISP fee levied on: Equity portion of portfolio Bond portion of portfolio	 0.25% 0.25%	
Net investment factor (NIF) for: Equity portion of portfolio Bond portion of portfolio	 97.78% 98.28%	
NIF is calculated as 1 minus the sum of the fees applicable to either the equity or bond portion of the portfolio.		
Living annuity investment costs are deducted from the portfolio at the end of each year, **after** *the last annuity payment out of the equity and bond portion of the portfolio is made,* **before** *the portfolio is rebalanced.*		
Investment performance for equities: Year 1		
The monthly performance of the retiree's retirement capital in equity is based on the assumptiom that the retiree buys the All Share Index at the start of his retirement and subsequently follows a buy and hold strategy.		

Table 4.2: Numerical example 1 (continued)

Dividend payments *(Dividends are reinvested in the index at the end of each month)*	$D_t = \frac{ALSI_t \times DY_t}{12}$ where D_t is the dividend payment for month t, $ALSI_t$ is the All Share Index for month t and DY_t is the Dividend Yield for month t	4.2
Dividends pay out smoothly over the year and are calculated using one twelfth of the quoted Dividend Yield (a percentage).		
Dividend payment for January 1987	$\frac{2130 \times 0.036}{12} = 6.39$	4.3
Overall return on equity portion of portfolio	$R_{E_t} = \frac{ALSI_t - ALSI_{t-1} + D_t}{ALSI_{t-1}} \times \frac{100}{1}$ where R_{Et} is the return on the equity portion of the portfolio for month t, $ALSI_t$ is the All Share Index for month t, $ALSI_{t-1}$ is the All Share Index for the previous month, and D_t is the dividend payout for month t	4.4
Overall return on equity portion of portfolio for January 1987	$\frac{2130 - 1981 + 6.39}{1981} \times \frac{100}{1} = 7.84\%$	4.5
Investment performance for bonds: Year 1		
The approach used in the calculation of the monthly bond performance is based on the assumption that the retiree buys the All Bond Index at the start of his retirement and subsequently follows a buy and hold strategy.		
Interest payments *(Interest received is reinvested in the index at the end of each month)*	$IP_t = \frac{ALBI_t \times IY_t}{12}$ where IP_t is the interest for month t, $ALBI_t$ is the All Bond Index for month t and IY_t, is the Interest Yield for month t	4.6
Interest pays out smoothly over the year and one twelfth of the quoted Interest Yield is used.		
Interest payment for January 1987	$\frac{115.13 \times 0.1433}{12} = 1.37$	4.7

Table 4.2: Numerical example 1 (continued)

Overall return on bond portion of portfolio	$R_{B_t} = \frac{ALBI_t - ALBI_{t-1} + IP_t}{ALBI_{t-1}} \times \frac{100}{1}$ where R_{Bt} is the return on the bond portion of the portfolio for month t, $ALBI_t$ is the All Bond Index for month t, $ALBI_{t-1}$ is the All Bond Index for the previous month, and IP_t is the interest payment for month t	4.8
Overall return on bond portion of portfolio for January 1987	$\frac{115.13 - 116.89 + 1.37}{116.89} \times \frac{100}{1} = -0.33\%$	4.9
Annuity payments: Year 1		
He invests R250000 in equity and R750000 in bonds on 1 January 1987	*25% initial investment amount* *75% initial investment amount*	
Value of equity portion of portfolio at end of January 1987	$250000 \times \left(1 + \frac{7.84}{100}\right) = 269610.05$	4.10
Value of bond portion of portfolio at end of January 1987	$750000 \times \left(1 + \frac{-0.33}{100}\right) = 747528.73$	4.11
Monthly annuity payment from equity portion of portfolio for 1987	$269610.05 \times 0.46\% = 1235.71$	4.12
Monthly annuity payment from bond portion of portfolio for 1987	$747528.73 \times 0.46\% = 3426.17$	4.13
The monthly annuity payment is calculated by multiplying the monthly withdrawal rate with the value of the equity and bond portion of the portfolio.		
Total monthly annuity payment paid out of portfolio in first year after retirement (1987)	$1235.71 + 3426.17 = 4661.89$	4.14
The total monthly annuity payment payable in the first year after retirement (1987) at the end of each month for 12 months, is calculated by adding the amounts in 4.12 and 4.13 together and stays fixed for the year, based on 0.46% multiplied with the end of January portfolio market value.		
At the end of each month units in the portfolio are sold to pay out the annuity amount.		

Table 4.2: Numerical example 1 (continued)

At the end of the first month, the first annuity payment payable out of the equity portion of the portfolio is deducted. The balance is invested and grows at the overall return on the equity portion of the portfolio applicable to February 1987.	$(269610.05 - 1235.71) \times \left(1 + \frac{-1.29}{100}\right)$ $= 264904.70$	4.15
At the end of the first month, the first annuity payment payable out of the bond portion of the portfolio is deducted. The balance is invested and grows at the overall return on the bond portion of the portfolio for February 1987.	$(747528.73 - 3426.17) \times \left(1 + \frac{1.56}{100}\right)$ $= 755704.20$	4.16
Deducting costs: Year 1		
At the end of the last month of the first year after retirement, the fees applicable to the equity portion of the portfolio are deducted from the closing value of the equity portion of the portfolio by multiplying this value with the NIF (i.e. 97.78%).	$(227147.40 - 1235.71) \times \frac{97.78}{100}$ $= 220896.45$	4.17
At the end of the last month of the first year after retirement, the fees applicable to the bond portion of the portfolio are deducted from the closing value of the bond portion of the portfolio by multiplying this value with the NIF (i.e. 98.28%).	$(820765.20 - 3426.17) \times \frac{98.28}{100}$ $= 803280.79$	4.18
The costs are deducted after the payment of the last monthly annuity for the year.		
Rebalancing: Year 1		
Add the amounts in 4.17 and 4.18 together, and multiply the result with the percentage that must be invested in equity (i.e. 25%).	$(220896.45 + 803280.79) \times \frac{25}{100}$ $= 256044.31$	4.19
Add the amounts in 4.17 and 4.18 together, and multiply the result with the percentage that must be invested in bonds (i.e. 75%).	$(220896.45 + 803280.79) \times \frac{75}{100}$ $= 768132.93$	4.20
Investment performance for equities: Year 2		
Value of equity portion of portfolio at end of January 1988	$256044.31 \times \left(1 + \frac{-13.47}{100}\right)$ $= 221566.30$	4.21

Table 4.2: Numerical example 1 (continued)

To calculate the amount invested in the equity portion of the portfolio before the first annuity payment is deducted for the second year, the amount in 4.19 is multiplied with one plus the overall return on equity for January 1988 (i.e. -13.47%).		
Investment performance for bonds: Year 2		
Value of bond portion of portfolio at end of January 1988	$768132.93 \times \left(1 + \frac{-4.22}{100}\right) = 735708.76$	4.22
To calculate the amount invested in the bond portion of the portfolio before the first annuity payment is deducted for the second year, the amount in 4.20 is multiplied with one plus the overall return on bonds for January 1988 (i.e. −4.22%).		
Annuity payments: Year 2		
Monthly annuity payment from equity portion of portfolio for 1988	$221566.30 \times 0.0046 = 1015.51$	4.23
The monthly annuity payment payable out of the equity portion of the portfolio for the second year after retirement (1988) is caculated by multiplying the amount in 4.21t with 0.46%.	*Monthly drawdown rate*	
Monthly annuity payment from bond portion of portfolio for 1988	$735708.76 \times 0.0046 = 3372.00$	4.24
The monthly annuity payment payable out of the bond portion of the portfolio for the second year after retirement (1988) is calculated by multiplying the amount in 4.22 with 0.46%.		
Total monthly annuity payment for 1988	$1015.50 + 3372.00 = 4387.51$	4.25
The total monthly annuity payment payable in the second year after retirement (1988) at the end of each month for 12 months, is calculated by adding the amounts in 4.23 and 4.24 together and stays fixed for the year.		
See Appendix B, Figure B.1 for a schematic illustration of this process.		
Discounting cash flows		
After obtaining all the monthly annuity payments (from January 1987 through January 2008), an annuity payment in month n is discounted at the geometric average of the monthly inflation rates through months one to n.		

Table 4.2: Numerical example 1 (continued)

Monthly inflation rate	$IR_t = \left(\frac{CPI_t}{CPI_{t-1}} - 1\right) \times \frac{100}{1}$ where IR_t is the inflation rate for month t, CPI_t is the Consumer Price Index for month t, and CPI_{t-1} is the Consumer Price Index for the previous month	4.26
The monthly inflation rate is the change in the CPI for all consumer products in the relevant month compared with the CPI for all consumer products in the previous month expressed as a percentage.		
Monthly inflation rate used to discount annuity payment payable at end of January 1987	$\left(\frac{16.83}{16.65} - 1\right) \times \frac{100}{1} = 1.13\%$	4.27
Present value of annuity payments (including remaining capital at death)	$PV_t = \frac{CF_1}{(I+IR_1)} + \frac{CF_2}{(1+IR_1)(I+IR_2)} + \frac{CF_3}{(1+IR_1)(1+IR_2)(1+IR_3)} + \cdots + \frac{CF_{253} + RCAD_{253}}{(1+IR_1)(1+IR_2)\ldots(1+IR_{253})}$ where PV_t is the present value of the cash flows from January 1987 through January 2008, CF_1 is the cash flow for January 1987, CF_2 is the cash flow for February 1987, CF_3 is the cash flow for March 1987, CF_{253} is the cash flow for January 2008, $RCAD_{253}$ is the remaining capital at the end of January 2008, IR_t is the inflation rate for month 1 (i.e. January 1987), IR_2 is the inflation rate for month 2 (i.e February 1987), IR_3 is the inflation rate for month 3 (i.e. March 1987) and IR_{253} is the inflation rate for month 253 (i.e. January 2008)	4.28

Table 4.2: Numerical example 1 (continued)

Present value of cash flows as at January 1987	$\frac{4661.89}{\left(1+\frac{1.13}{100}\right)}+\frac{4661.89}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)}$ $+\frac{4661.89}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)\left(1+\frac{1.47}{100}\right)}+\cdots+$ $\frac{24059.87+5249425.71}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)\cdots\left(1+\frac{1.14}{100}\right)}$ $=1863300.66$	4.29

*F refers to formula number

Source: Author, 2012.

4.2.2 Life annuity strategies

The second step of the study was to calculate the present values of the monthly cash flows provided by two life annuity strategies in order to establish which strategy provided the largest financial benefit in present value terms.

For male annuitants retiring at the ages of 55, 60 and 65 respectively, during the period 1960 to 1989, the present values were calculated of the monthly cash flows provided by a single life annuity, with a 10-year guaranteed term.

Two strategies were considered: a level annuity and an annuity increasing by 5% every year.

Life annuities increasing by the inflation rate every year were not considered. These annuities have only been marketed since 2005, as inflation-linked bonds, which are the underlying investments that match these annuities, have only come into existence approximately 15 years ago.

With-profit annuities, which came into existence in the 1990s were also not considered as they are mainly marketed on an institutional basis for retirement funds, and not for individuals.

The annuity rates used in this study were provided by Sanlam (see Appendix C, Table C.1). The annuity rates supplied by Sanlam are expressed as a multiple of 10 000 units. The monthly annuity payment of a R1 million investment was calculated as follows:

$$AP_t = 1000000 \times \frac{AR_t}{10000} \qquad \text{(Formula 4.30)}$$

where AP_t is the annuity payment in month t, and AR_t is the annuity rate in month t.

Initial commission of 1.71% including VAT was deducted from the consideration before the cash flows were calculated.

The present values of cash flows were calculated per R1 million invested.

The discount rate used to discount the annuities for a cash flow in month n was the geometric average of the inflation rates through months one to n (see numerical example 2 in Table 4.3).

It was assumed that the males (aged 55, 60 and 65) retired every year, at the beginning of that year, during the period 1960 to 1989, and that their life expectancy was that of the a (55) life mortality table as published by the Cambridge University Press in 1953 (Botha *et al.*, 2011: 1056) (see discussion in Section 4.2.1).

As this study is based on historical data available up to December 2010, a sub-period of 30 years was used (1960 to 1989) to ensure that the time period includes the expected date of decease of a male.

For the life annuity strategies, the present values of cash flows for 180 combinations (two life annuity strategies for three retirement ages over 30 years) were calculated (see Appendix A, Table A.2).

In order to explain the layout of the spreadsheet used to do the calculations, a numerical example is now presented. For easy reading, all amounts in the numerical example have been rounded off to the second decimal. No amounts were rounded off in doing the calculations in the spreadsheet.

Table 4.3: Numerical example 2

Background		**F***
Assume a male, aged 55, retires on 1 January 1987 with an investment amount of R1 million.		
Date of death *According to the a (55) life mortality table, table, this male annuitant has a life expectancy of 21 years, but as the first annuity payment is received at the end of January 1987, the last annuity payment is only received at the end of January 2008.*	31 January 2008	
He effects a single life level annuity with a guaranteed term of 10 years.		
Annuity rate as at 1 January 1987	118.78 (see Appendix C, Table C.1)	
Annuity payments		
Annuity payments	$1000000 \times \frac{118.78}{10000} = 11878$	4.31
He receives R11878 at the end of every month until his death on 1 January 2008.		
Discounting cash flows		
After obtaining all the monthly annuity payments (from January 1987 through January 2008), an annuity payment in month n is discounted at the geometric average of the monthly inflation rates through months one to n.		
Present value of annuity payments	$PV_t = \frac{CF_1}{(1+IR_1)} + \frac{CF_2}{(1+IR_1)(1+IR_2)} + \frac{CF_3}{(1+IR_1)(1+IR_2)(1+IR_3)} + \cdots + \frac{CF_{253}}{(1+IR_1)(1+IR_2)\ldots(1+IR_{253})}$ where PV_t is the present value of the cash flows from January 1987 through January 2008, CF_1 is the cash flow for	4.32

Table 4.3: Numerical example 2 (continued)

	January 1987, CF_2 is the cash flow for February 1987, CF_3 is the cash flow for March 1987, CF_{253} is the cash flow for January 2008, IR_1 is the is inflation rate for month 1 (i.e. January 1987), IR_2 is the inflation rate for month 2 (i.e. February 1987), IR_3 is the inflation rate for month 3 (i.e. March 1987) and IR_{253} is the inflation rate for month 253 (i.e. January 2008)	
Present value of cash flows as at January 1987	$\frac{11878}{\left(1+\frac{1.13}{100}\right)} + \frac{11878}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)} + \frac{11878}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)\left(1+\frac{1.47}{100}\right)} + \cdots + \frac{11878}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)\cdots\left(1+\frac{1.14}{100}\right)}$ $= 1184644.27$	4.33

*F refers to formula number

Source: Author, 2012.

4.2.3 Composite annuity strategy

The third step of the study was to calculate the present values of the monthly cash flows provided by a composite annuity strategy in order to establish the financial benefits in present value terms of combining living annuity strategies with life annuity strategies.

For male annuitants retiring at ages 55, 60 and 65 respectively during the period 1960 to 1989, the present values were calculated of the monthly cash flows provided by composite annuity strategies with a 50/50 split between a life and a living annuity strategy.

The present values of cash flows were calculated per R1 million invested.

The discount rate used to discount the annuities for a cash flow in month n, was the geometric average of the inflation rates through months one to n.

It was assumed that the males (aged 55, 60 and 65) retired every year, at the beginning of that year, during the period 1960 to 1989, and that their life expectancy was that of the a (55) life mortality table as published by the Cambridge University Press in 1953 (Botha *et al.*, 2011: 1056) (see discussion in Section 4.2.1).

As this study is based on historical data available up to December 2010, a sub-period of 30 years was used (1960 to 1989) to ensure that the time period includes the expected date of decease of a male.

Each life annuity strategy was combined with each living annuity strategy (see Section 4.2.1 and Section 4.2.2).

There were 1620 combinations (nine living annuity strategies combined with two life annuity strategies for three retirement ages over 30 years) as shown in Appendix A, Table A.3.

In order to explain the layout of the spreadsheet used to do the calculations, a numerical example is now presented. For easy reading, all amounts in the numerical example have been rounded off to the second decimal. No amounts were rounded off in doing the calculations in the spreadsheet.

Table 4.4: Numerical example 3

Background		**F***
Assume a male, aged 55, retires on 1 January 1987 with an investment amount of R1 million.		
Date of death *According to the a (55) life mortality table, this male annuitant has a life expectancy of 21 years, but as the first annuity payment is received at the end of January 1987, the last annuity payment is only received at the end of January 2008.*	31 January 2008	
He invests R500000 in a living annuity, and R500000 in a single life level annuity, with a guaranteed term of 10 years.		
With respect to the amount invested in a living annuity, he invests according to a conservative risk profile.	25% of the investment amount in equity and 75% in bonds	
Initial annual drawdown rate	5.5% *(see Table 4.1)*	
Annual drawdown rate is maintained throughout	*See drawdown strategy a in Section 4.2.1*	
Monthly drawdown rate	$\frac{5.5\%}{12} = 0.46\%$	4.34
Annuity rate as at 1 January 1987	118.78	
Costs		
The living annuity investment attracts the same costs as in numerical example 1		
Annuities		
The cash flows from the living annuity investment are calculated as in numerical example 1.		
The cash flows from the life annuity investment are calculated as in numerical example 2.		

Table 4.4: Numerical example 3 (continued)

Discounting cash flows		
After obtaining all the monthly annuity payments (from January 1987 through January 2008), an annuity payment in month n is discounted at the geometric average of the monthly inflation rates through months one to n.		
Present value of living annuity strategy as at 1 January 1987	$\frac{2330.94}{\left(1+\frac{1.13}{100}\right)}+\frac{2330.94}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)}+$ $\frac{2330.94}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)\left(1+\frac{1.47}{100}\right)}+\cdots+$ $\frac{12029.93+2624712.86}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)\cdots\left(1+\frac{1.14}{100}\right)}$ $=931650.33$	4.35
Present value of life annuity strategy as at 1 January 1987	$\frac{5939}{\left(1+\frac{1.13}{100}\right)}+\frac{5939}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)}+$ $\frac{5939}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)\left(1+\frac{1.47}{100}\right)}+\cdots+$ $\frac{5939}{\left(1+\frac{1.13}{100}\right)\cdots\left(1+\frac{1.49}{100}\right)\left(1+\frac{1.14}{100}\right)}$ $=592322.13$	4.36
Present value of composite annuity strategy as at 1 January 1987	$931650.33+592322.13=1523972.46$	4.37
The present value of the composite annuity strategy is calculated by adding the amounts in 4.35 and 4.36 together.		

*F refers to formula number

Source: Author, 2012.

4.2.4 Switching annuity strategy

The fourth step of the study was to calculate the present values of the monthly cash flows provided by a switching annuity strategy in order to establish the financial benefits in present value terms of switching from a living annuity strategy to a life annuity strategy 10 years after retirement.

For male annuitants retiring at ages 55, 60 and 65 respectively during the period 1960 to 1989, the present values were calculated of the monthly cash flows provided by a living annuity, which had been switched to a life annuity ten years after the annuitant had retired, by using the remaining living annuity capital to purchase a life annuity at prevailing annuity rates.

The present values of cash flows were calculated per R1 million invested.

The discount rate used to discount the annuities for a cash flow in month n, was the geometric average of the inflation rates through months one to n.

It was assumed that the males (aged 55, 60 and 65) retired every year, at the beginning of that year, during the period 1960 to 1989, and that their life expectancy was that of the a (55) life mortality table as published by the Cambridge University Press in 1953 (Botha *et al.*, 2011: 1056) (see discussion in Section 4.2.1).

As this study is based on historical data available up to December 2010, a sub-period of 30 years was used (1960 to 1989) to ensure that the time period includes the expected date of decease of a male.

Each living annuity strategy was switched to each life annuity strategy (see Section 4.2.1 and Section 4.2.2)

There were 1620 combinations (nine living annuity strategies switched to two life annuity strategies for three retirement ages over 30 years) as shown in Appendix A, Table A.4.

In order to explain the layout of the spreadsheet used to do the calculations, a numerical example is now presented. For easy reading, all amounts in the numerical example have been rounded off to the second decimal. No amounts were rounded off in doing the calculations in the spreadsheet.

Table 4.5: Numerical example 4

Background		**F***
Assume a male, aged 55, retires on 1 January 1987 with an investment amount of R1 million.		
Date of death *According to the a (55) life mortality table, this male annuitant has a life expectancy of 21 years, but as the first annuity payment is only received at the end of January 1987, the last annuity payment is only received at the end of January 2008.*	31 January 2008	
He initially invests the full R1 million in a living annuity on 1 January 1987.		
With respect to the amount invested in a living annuity, he invests according to a conservative risk profile.	25% of the investment amount in equity and 75% in bonds	
Initial annual drawdown rate	5.5% *(see Table 4.1)*	
Annual drawdown rate is maintained throughout	*See drawdown strategy a in Section 4.2.1*	
Monthly drawdown rate	$\frac{5.5\%}{12} = 0.46\%$	4.38
At age 65, ten years after retirement, he switches to a single life level annuity with a guaranteed term of 10 years, by using the remaining living annuity capital to purchase a life annuity at the prevailing annuity rates.		
Annuity rate as at 1 January 1997	125.81 *(see Appendix C, Table C.1)*	
Costs		
The annuity strategies attract the same costs as in numerical example 1 and 2		
Annuities		
The cash flows from the living annuity investment are calculated as in numerical example 1		
The cash flows from the life strategy are calculated as in numerical example 2.		
Discounting cash flows: Living annuity strategy		
After obtaining all the monthly annuity payments (from January 1987 through December 1996), an annuity payment in month n is discounted at the geometric average of the monthly inflation rates through months one to n.		

Table 4.5: Numerical example 4 (continued)

Present value of living annuity strategy	$PV_t = \frac{CF_1}{(1+IR_1)} + \frac{CF_2}{(1+IR_1)(1+IR_2)} + \frac{CF_3}{(1+IR_1)(1+IR_2)(1+IR_3)} + \cdots + \frac{CF_{120}}{(1+IR_1)(1+IR_2)\ldots(1+IR_{120})}$ where PV_t is the present value of the cash flows from January 1987 through December 1996, CF_1 is the cash flow for January 1987, CF_2 is the cash flow for February 1987, CF_3 is the cash flow for March 1987, CF_{120} is the cash flow for December 1996, IR_1 is the is inflation rate for month 1 (i.e. January 1987), IR_2 is the inflation rate for month 2 (i.e. February 1987), IR_3 is the inflation rate for month 3 (i.e. March 1987) and IR_{120} is the inflation rate for month 120 (i.e. December 1996)	4.39
Present value of living annuity strategy as at 1 January 1987	$\frac{4661.89}{\left(1+\frac{1.13}{100}\right)} + \frac{4661.89}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)} + \frac{4661.89}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)\left(1+\frac{1.47}{100}\right)} + \cdots + \frac{10798.02}{\left(1+\frac{1.13}{100}\right)\left(1+\frac{1.49}{100}\right)\cdots\left(1+\frac{1}{100}\right)} = 427130.56$	4.40
Discounting cash flows: Life annuity strategy		
Remaining balance in living annuity investment after ten years have lapsed.	R2271937	
The remaining balance in the living annuity investment was used to purchase a life level annuity.		
Monthly annuity payments from life annuity strategy payable up until 1 January 2008	$2271937 \times \frac{125.81}{10000} = 28583.24$	4.41

Table 4.5: Numerical example 4 (continued)

Present value of life annuity strategy	$PV_t = \frac{CF_{121}}{(1+IR_{121})(1+IR_{120})\dots(1+IR_1)}$ $+\frac{CF_{122}}{(1+IR_{122})(1+IR_{121})\dots(1+IR_1)}+$ $\frac{CF_{123}}{(1+IR_{123})(1+IR_{122})\dots(1+IR_1)}+\cdots$ $+\frac{CF_{253}}{(1+IR_{253})(1+IR_{252})\dots(1+IR_1)}$ where PV_t is the present value of the cash flows from January 1997 through January 2008, CF_1 is the cash flow for January 1997, CF_2 is the cash flow for February 1997, CF_3 is the cash flow for March 1997, CF_{253} is the cash flow for January 2008, IR_1 is the is inflation rate for month 1 (i.e. January 1987), IR_2 is the inflation rate for month 2 (i.e. February 1987), IR_3 is the inflation rate for month 3 (i.e. March 1987) and IR_{253} is the inflation rate for month 253 (i.e. January 2008)	
Present value of life annuity strategy as at 1 January 1987	$\frac{28583.24}{\left(1+\frac{1.23}{100}\right)\left(1+\frac{1}{100}\right)\cdots\left(\frac{1.13}{100}\right)}+$ $\frac{28583.24}{\left(1+\frac{0.61}{100}\right)\left(1+\frac{1.23}{100}\right)\cdots\left(1+\frac{1.13}{100}\right)}+$ $\frac{28583.34}{\left(1+\frac{0.61}{100}\right)\left(1+\frac{0.61}{100}\right)\cdots\left(1+\frac{1.13}{100}\right)}\cdots+$ $\frac{28583.24}{\left(1+\frac{1.14}{100}\right)\left(1+\frac{0.88}{100}\right)\cdots\left(1+\frac{1.13}{100}\right)}$ $= 915372.91$	4.43
Present value of switching annuity strategy as at 1 January 1987	$427130.56 + 915372.91 = 1342503.47$	4.44
The present value of the switching annuity strategy is calculated by adding the amounts in 4.40 and 4.43 together		

*F refers to formula number Source: Author, 2012.

In this chapter the methodology followed to conduct the study was given. In Chapter 5, a discussion of the results is presented.

Chapter 5

Results

As the purpose of this study is to establish which of various annuity strategies would have been best to follow in the 30 years from 1960 to 1989, the present values of the monthly cash flows provided by:

- nine living annuity strategies (three drawdown strategies combined with three asset allocations),
- two life annuity strategies,
- 18 composite annuity strategies (nine living annuity strategies combined with two life annuity strategies), and
- 18 switching annuity strategies (nine living annuity strategies switched to two life annuity strategies),

were calculated in order to ascertain which strategy provided the largest financial benefits in present value terms. The present value for each of these strategies was calculated for male annuitants retiring at ages 55, 60 and 65 respectively.

For ease of reference the annuity strategies are expressed by an acronym of its parameters as best indicated by the following examples:

- Lif-5%-60: a pure life annuity increasing by 5% per annum and a retirement age of 60;
- Liv-A-b-55: a pure living annuity with asset allocation A, drawdown strategy b and retirement age 55;
- C[Liv-B-c-60-0%]: a composite strategy between a living annuity with asset allocation B, drawdown strategy c, retirement age 60 and a level life annuity;
- S[Liv-C-a-65-5%]: switching from a living annuity with asset allocation C, drawdown strategy a and retirement age 65 to a life annuity increasing by 5% per year.

Living annuity strategies are analysed in Section 5.1, followed by an investigation of life annuity strategies in Section 5.2. Composite annuity strategies are examined in Section 5.3, followed in Section 5.4, by an exploration of switching annuity strategies. Finally, the different annuity strategies are compared with each other in Section 5.5.

5.1 Living annuity strategies

In Section 5.1.1 background information on nine living annuity strategies is given, followed by an analysis of the present values of living annuity strategies in Section 5.1.2. In Section 5.1.3 certain key performance indicators (KPIs) are presented and discussed, in order to facilitate the evaluation and comparison of living annuity strategies.

5.1.1 Background information on nine living annuity strategies

For ease of reference a brief synopsis of Section 4.2.1 is provided in this section.

For male annuitants retiring at the ages of 55, 60 and 65 respectively, during the period 1960 to 1989, the present values of monthly cash flows provided by three living annuity drawdown strategies, as follows:

a. Maintaining the same drawdown rate throughout;

b. Adjusting the drawdown rate each year to increase the Rand amount of income by 5% per annum, but staying within the legal limits of between 2.5% and 17.5% of the underlying investment value; and

c. Adjusting the drawdown rate each year to increase the Rand amount of income by the annual inflation rate, again remaining within the legal limits

were calculated, using existing equity and bond market index data with the following assumed asset allocations, given as:

A. A conservative (25% equity; 75% bonds) risk profile;

B. A moderate (50% equity; 50% bonds) risk profile; and

C. An aggressive (75% equity; 25% bonds) risk profile.

The initial drawdown rates followed the recommendations of the LOA's Code on Living Annuities (LOA, 2008) and are given in Table 4.1. Living annuity investments attract a number of costs. The following costs were taken into account in the calculations:

- An underlying base asset management fee including VAT of 1.4% per annum on the equity portion of the portfolio, and 0.9% per annum on the bond portion of the portfolio;

- An annual adviser's fee of 0.57% including VAT; and
- A Linked Investment Service Provider (LISP) fee of 0.25% per annum on the equity and bond portion of the portfolio respectively.

The portfolios were rebalanced annually to maintain asset allocations.

The present values of cash flows were calculated per R1 million invested. The present value of the remaining captial at death was also included.

The discount rate used to discount the annuities for a cash flow in month n, was the geometric average of the inflation rates through months one to n (see numerical example 1 in Table 4.2).

It was assumed that the male annuitants (aged 55, 60 and 65) retired every year, at the beginning of that year, during the period 1960 to 1989. It was assumed that the male aged 55, 60 and 65 had a life expectancy of 21, 18 and 14 years respectively (see discussion in Section 4.2.1).

5.1.2 Analysing the present values of nine living annuity strategies

For living annuity strategies, the present values of cash flows for 810 combinations (three drawdown strategies combined with three asset allocations for three retirement ages over 30 years of retirement dates) were calculated (see Appendix A, Table A.1).

In Figure 5.1, Figure 5.2 and Figure 5.3, living annuity strategies are grouped together according to underlying asset allocations per retirement age. As there are three different asset allocations (see A-C in Section 5.1.1) and three different drawdown strategies (see a-c in Section 5.1.1), the green lines in the graphs represent three living annuity strategies with a conservative (25% equity; 75% bonds) risk profile. The blue lines represent three living annuity strategies with a moderate (50% equity; 50% bonds) risk profile, and the red lines represent three living annuity strategies with an aggressive (75% equity; 25% bonds) risk profile. Every point on the graph represents the present values of cash flows for a specific strategy received from retirement up until death.

The ranking of the drawdown strategies is discussed in Section 5.1.3.

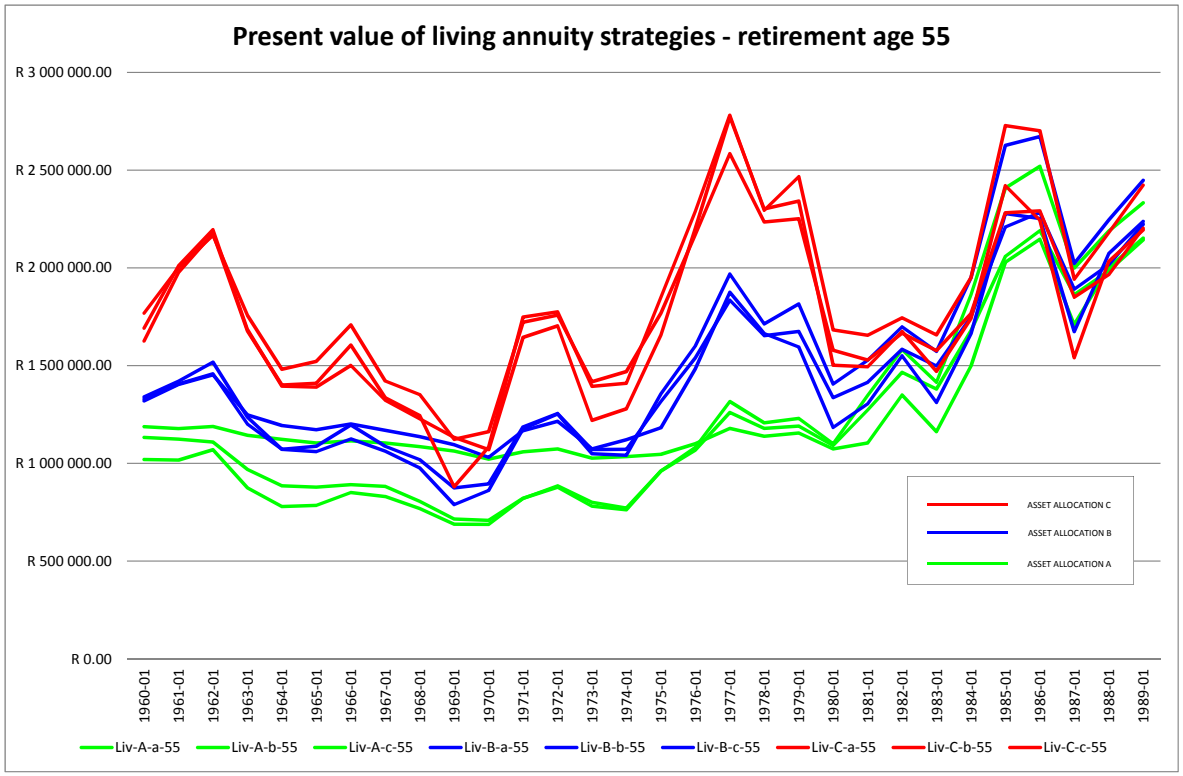

Figure 5.1: Present values of living annuity strategies for a male retiree aged 55

Source: Author, 2012.

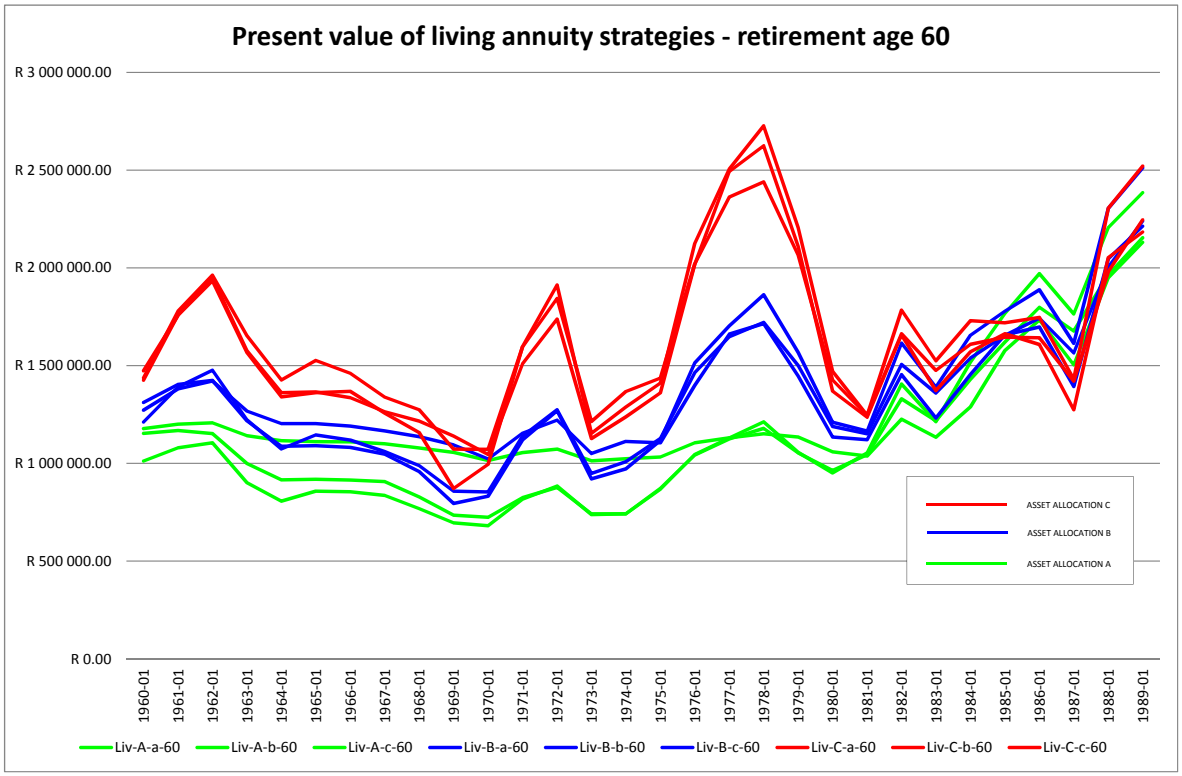

Figure 5.2: Present values of living annuity strategies for a male retiree aged 60

Source: Author, 2012.

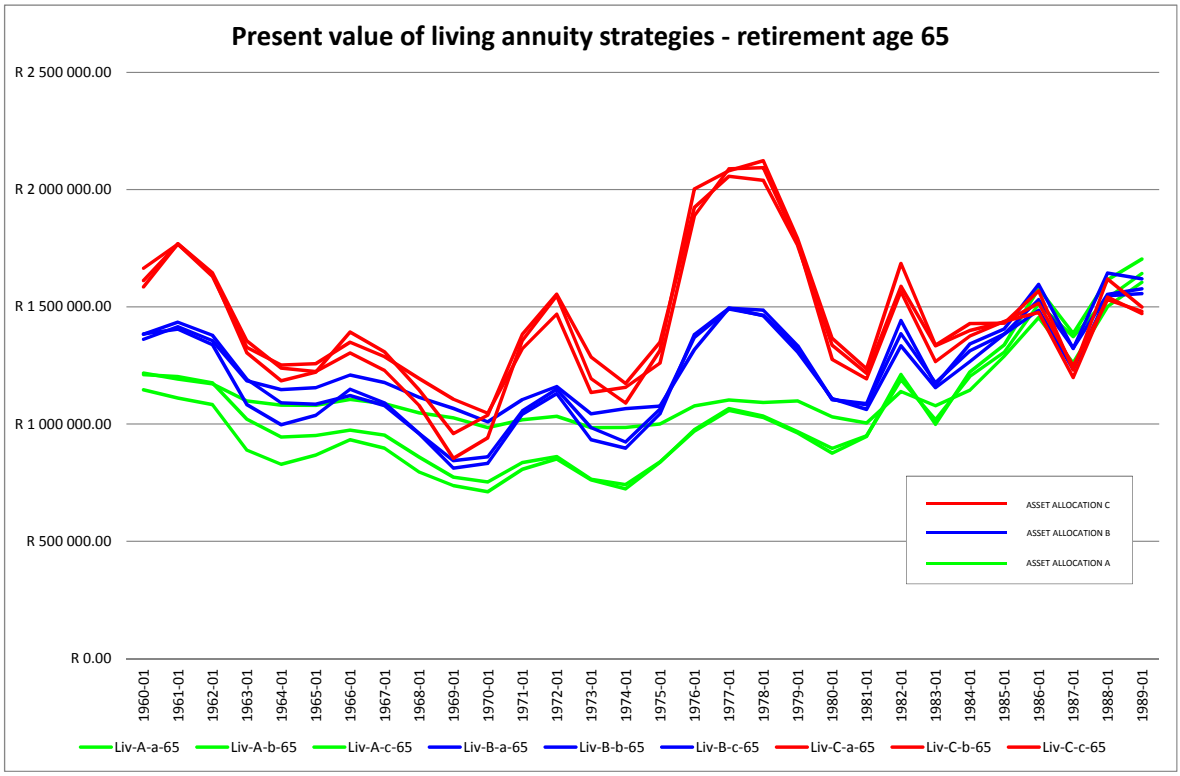

Figure 5.3: Present values of living annuity strategies for a male retiree aged 65

Source: Author, 2012.

It is evident from the graphs in Figure 5.1 to 5.3 that the red lines are superior to the blue lines which, in turn, outperform the green lines. This is the main trend up until the early 1980s and is confirmed by theory, which suggests that equity outperforms bonds in the long run. It is also interesting to note that in most of the 30 years, a male retiree invested in a conservative risk profile did not yield a good return on his initial R1 million investment, as the current value (as at retirement date) of the cash flows received, including the remaining capital at death (RCAD), is less than the initial capital sum. This trend is evident from the early 1960s up until approximately the early 1980s, which could be explained by the fact that bonds, with a weighting of 75% for a conservative risk profile, delivered insufficient return compared to that delivered by equities. From the early 1980s until 1989, however, the moderate and conservative risk profile portfolios outperformed the aggressive risk profile portfolios occasionally.

This could be explained by analysing bond returns, relative to equity returns from the 1990s up until the early 2000s. Bonds outperformed equities from the early 1990s up until 2005 as a result of monetary policy tightening. The Governor of the Reserve Bank, Dr Stals, put measures in

place in the early 1990s to bring inflation and inflation expectations down, which in turn led to exceptionally high interest rates.

With the introduction of formal inflation targets in 2001, inflation came down even further with the exception of 2002. South African bonds outperformed equities for the period 1990 to 2005, with bonds delivering an average rate of 22.0% per annum against a rate of 17.5% per annum for South African equities (Harmse, 2006).

The period of bond outperformance relative to equities in South Africa therefore affected the present value of living annuity strategies for annuitants retiring in the early 1980s up until 1989, as the period of bond outperformance is included in their retirement years.

It must be noted that, in all of the annuity options which included full or partial living annuity strategies (pure living, switching and composite annuity strategies - 4050 combinations), capital was never depleted during the retiree's lifetime. This is mainly due to the maximum restriction set on the annual drawdown percentage.

5.1.3 Key performance indicators (KPIs)

Four KPIs were developed as measures by which living annuity strategies could be evaluated. KPIs include average rank, best rank, number of victories (NOV), and percentile. The results for the KPIs for male retirees aged 55, 60 and 65 respectively are summarised in Table 5.1 to 5.3. It should be noted that all options were sorted by average rank. In Figure 5.4 to 5.6 a graphical representation of the average rank KPI for male retirees aged 55, 60 and 65 respectively is given. A discussion of each of the KPIs for male retirees aged 55, 60 and 65 respectively follows in Section 5.1.3.1 to 5.1.3.3. In Section 5.1.3.4 a discussion on the living annuity strategies' overall rank is given.

Table 5.1: Nine living annuity strategies ranked by average rank for a male retiree aged 55

Retirement age 55					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	Liv-C-b-55	1.87	1	12	100%	100%	97%	40%
2	Liv-C-a-55	2.63	1	10	97%	90%	77%	33%
3	Liv-C-c-55	3.30	1	4	97%	87%	77%	13%
4	Liv-B-b-55	4.33	1	4	100%	67%	30%	13%
5	Liv-B-a-55	5.17	4	0	100%	67%	0%	0%
6	Liv-B-c-55	5.37	3	0	90%	47%	3%	0%
7	Liv-A-b-55	6.73	2	0	43%	20%	17%	0%
8	Liv-A-c-55	7.27	4	0	63%	20%	0%	0%
9	Liv-A-a-55	8.33	5	0	10%	3%	0%	0%

Source: Author, 2012.

Table: 5.2: Nine living annuity strategies ranked by average rank for a male retiree aged 60

Retirement age 60					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	Liv-C-b-60	2.20	1	14	100%	97%	87%	47%
2	Liv-C-a-60	2.53	1	12	97%	87%	83%	40%
3	Liv-C-c-60	3.23	1	1	93%	90%	77%	3%
4	Liv-B-b-60	4.67	1	1	100%	63%	23%	3%
5	Liv-B-c-60	5.17	2	0	97%	50%	7%	0%
6	Liv-B-a-60	5.27	4	0	100%	63%	0%	0%
7	Liv-A-c-60	6.83	4	0	73%	27%	0%	0%
8	Liv-A-b-60	6.93	1	2	30%	17%	17%	7%
9	Liv-A-a-60	8.17	2	0	10%	7%	7%	0%

Source: Author, 2012.

Table: 5.3: Nine living annuity strategies ranked by average rank for a male retiree aged 65

Retirement age 65					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	Liv-C-b-65	2.47	1	11	97%	93%	83%	37%
2	Liv-C-a-65	2.67	1	8	93%	90%	83%	27%
3	Liv-C-c-65	2.93	1	7	90%	87%	87%	23%
4	Liv-B-b-65	4.86	1	2	100%	63%	10%	7%
5	Liv-B-c-65	4.87	2	0	100%	60%	10%	0%
6	Liv-B-a-65	5.23	3	0	100%	67%	3%	0%
7	Liv-A-c-65	6.70	3	0	77%	20%	3%	0%
8	Liv-A-b-65	7.23	1	2	30%	13%	13%	7%
9	Liv-A-a-65	8.03	2	0	13%	7%	7%	0%

Source: Author, 2012.

5.1.3.1 Average rank

Average rank for nine different living annuity strategies was calculated by firstly ranking the strategies' present values for each year (from 1960 to 1989) from one (the best option) to nine (the worst option). The average rank for each strategy was then calculated by adding the rankings for each year (from 1960 to 1989) and by then dividing the total by 30 (number of years from 1960 to 1989), as follows:

$$\text{AverageRank} = \frac{\Sigma \text{rankings}}{30} \qquad \text{(Formula 5.1)}$$

The average rank is also schematically illustrated in Figure 5.4 to 5.6.

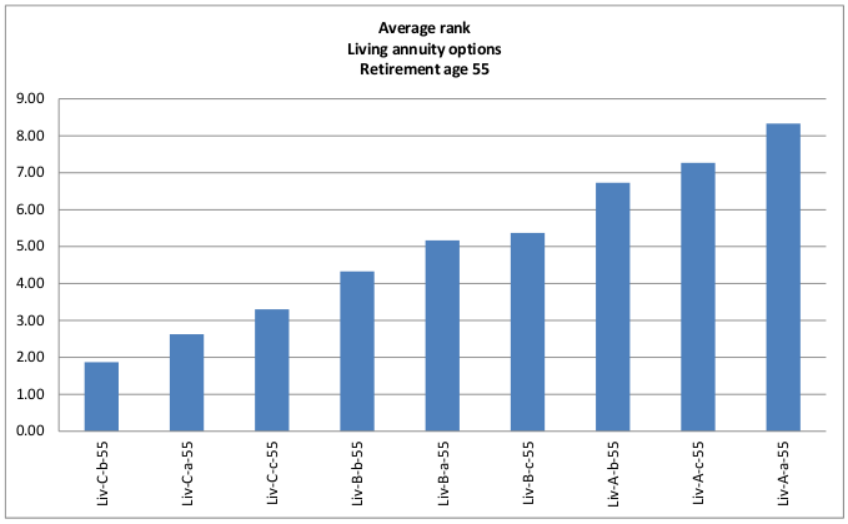

Figure: 5.4: Average rank for nine living annuity strategies for a male retiree aged 55

Source: Author, 2012.

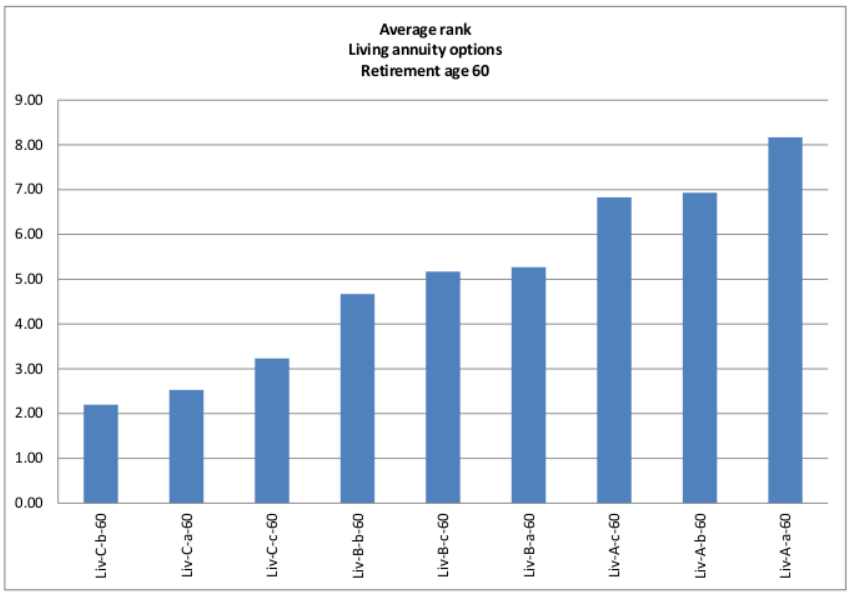

Figure: 5.5: Average rank for nine living annuity strategies for a male retiree aged 60

Source: Author, 2012.

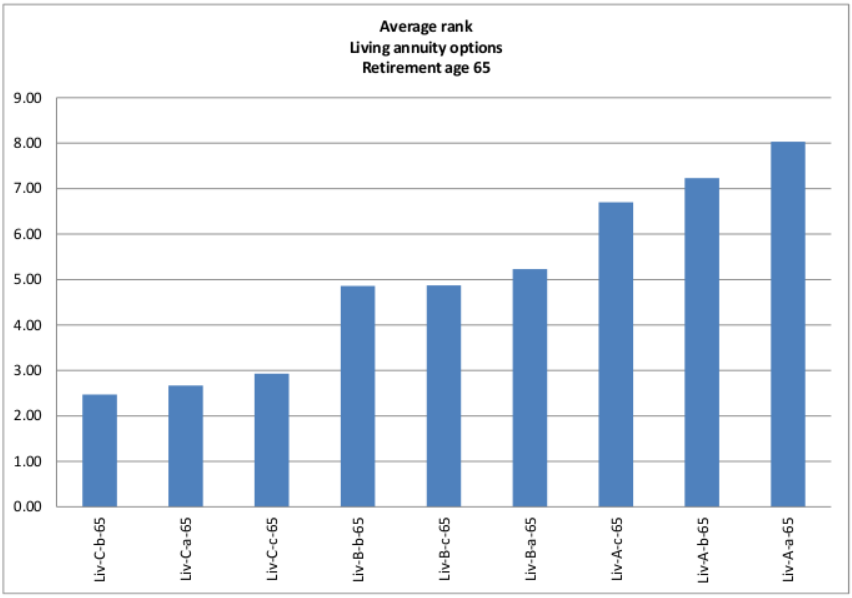

Figure: 5.6: Average rank for nine living annuity strategies for a male retiree aged 65

Source: Author, 2012.

a) **For a male retiree aged 55**

According to the average rank KPI, living annuity strategies with 75% invested in equity outperformed the strategies with less exposure to equity (50% followed by 25% invested in equity), irrespective of the drawdown strategy chosen. Moreover, drawdown strategy b seems to outperform drawdown strategy a and c for all asset allocations.

b) **For a male retiree aged 60**

Similarly living annuity strategies with the maximum exposure to equity outperformed the strategies with less equity exposure (asset allocation B, followed by A), irrespective of the drawdown option chosen. Moreover, drawdown strategy b is shown to be superior to the other drawdown strategies for aggressive and moderate risk profiles, whereas drawdown option c was the best option for a conservative risk profile.

c) **For a male retiree aged 65**

In the same fashion living annuity strategies with the maximum exposure to equity (asset allocation C) outperformed the other annuity strategies with less equity exposure (asset allocation B, followed by asset allocation A). Also, drawdown strategy b seems to be the superior drawdown strategy for aggressive and moderate portfolios, whereas drawdown option c outperformed the other strategies for a conservative risk profile.

5.1.3.2 Best rank and number of victories (NOV)

Best rank refers to the best rank awarded to a specific living annuity strategy over 30 years, from 1960 to 1989. NOV refers to the number of times a strategy was the best strategy for a single year. These indicators, however, do not carry significant weight and were merely included as a matter of interest.

a) **For a male retiree aged 55**

   According to the NOV KPI, Liv-C-b-55 achieved first place 12 out of 30 years, and Liv-C-a-55 10 out of 30 years.

b) **For a male retiree aged 60**

   In the same fashion, according to the NOV KPI, Liv-C-b-60 was the best strategy 14 out of 30 years, and Liv-C-a-60, 12 out of 30 years.

c) **For a male retiree aged 65**

   Similarly, according to the NOV KPI, Liv-C-b-65 performed best 11 out of 30 times, Liv-C-a-65 eight out of 30 times and Liv-C-c-65 seven out of 30 times.

5.1.3.3 Percentiles

A percentile is a value that represents a position in a range of data (Business Dictionary, 2012a). For example, if Liv-A-c-55 is at the 20th percentile, then it performs better than 20% of nine different living annuity strategies in the dataset. A quintile is one of four values (20th, 40th, 60th, 80th quintile) that divide a range of data into five equal parts, each being 20% of the range (Business Dictionary, 2012b).

For each year (from 1960 to 1989) the 20th, 40th, 60th and 80th percentile of the present values for nine different living annuity strategies were calculated. For example, if the value for the 20th percentile was calculated to be R500 000, it means that 20% of all the values in the dataset are less than R500 000. The same principle applies to the 40th, 60th and 80th percentile.

After the 20th, 40th, 60th and 80th percentiles had been calculated, the number of years for which each strategy's present value was above the 20th, 40th, 60th and 80th percentile was added. Subsequently the percentage of time each strategy was above the 20th, 40th, 60th and 80th percentile was calculated as follows:

$$\%\text{ of years above } N^{\text{th}} \text{ percentile} = \left(\frac{\text{Number of years above } N^{\text{th}} \text{ percentile}}{30 \text{ years}}\right) \times 100$$

(Formula 5.2)

For all age groups there was a good correlation between the average rank, best rank and NOV and the 80% percentile KPI.

5.1.3.4 Overall rank

The nine different living annuity strategies were ranked from one (the overall winner) to nine (the worst strategy) according to their average ranking over the 30 years from 1960 to 1989 for a male retiree aged 55, 60 and 65 respectively.

The overall best performers for the three retirement ages were as follows:

- Age 55: Liv-C-b-55
- Age 60: Liv-C-b-60
- Age 65: Liv-C-b-65

The overall worst performers for the three retirement ages were as follows:

- Age 55: Liv-A-a-55
- Age 60: Liv-A-a-60
- Age 65: Liv-A-a-65

5.2 Life annuity strategies

In Section 5.2.1 background information on two life annuity strategies is given, followed by an analysis of the present values of two life annuity strategies in Section 5.2.2. In Section 5.2.3 the previously mentioned KPIs are presented and discussed in order to facilitate the evaluation and comparison of the two life annuity strategies.

5.2.1 Background information on two life annuity strategies

For ease of reference a brief synopsis of Section 4.2.2 is provided in this section.

For male annuitants retiring at the ages of 55, 60 and 65 respectively, during the period 1960 to 1989, the present values of the monthly cash flows provided by a single life annuity were calculated, with a 10-year guaranteed term.

Two strategies were considered: a level annuity and an annuity increasing by 5% every year.

The annuity rates used in this study were provided by Sanlam (see Appendix C, Table C.1).

Initial commission of 1.71% including VAT was deducted from the consideration before the cash flows were calculated.

The present values of cash flows were calculated per R1 million invested.

The discount rate used to discount the annuities for a cash flow in month n was the geometric average of the inflation rates through months one to n (see numerical example 2 in Table 4.3).

It was assumed that the males (aged 55, 60 and 65) retired every year, at the beginning of that year, during the period 1960 to 1989, and that their life expectancy was that of the a (55) life mortality table as published by the Cambridge University Press in 1953 (Botha *et al.*, 2011: 1056) (see discussion in Section 4.2.1).

As this study is based on historical data available up to December 2010, a sub-period of 30 years was used (1960 to 1989) to ensure that the time period includes the expected date of decease of a male.

5.2.2 Analysing the present values of two life annuity strategies

For life annuity strategies, the present values of cash flows for 180 combinations (two life annuity strategies for three retirement ages over 30 years of retirement dates) were calculated (see Appendix A, Table A.2) and were plotted against retirement date in Figure 5.7. Therefore every point on the graph represents the present values of cash flows for a life annuity strategy received from retirement up until death.

In Figure 5.7 the purple lines depict the present values of level life annuity strategies for three retirement ages (55, 60 and 65) with retirement dates from 1960 up until 1989. The green lines in the graph depict the present values of life annuities increasing by 5% each year for three retirement ages (55, 60 and 65) with retirement dates from 1960 up until 1989.

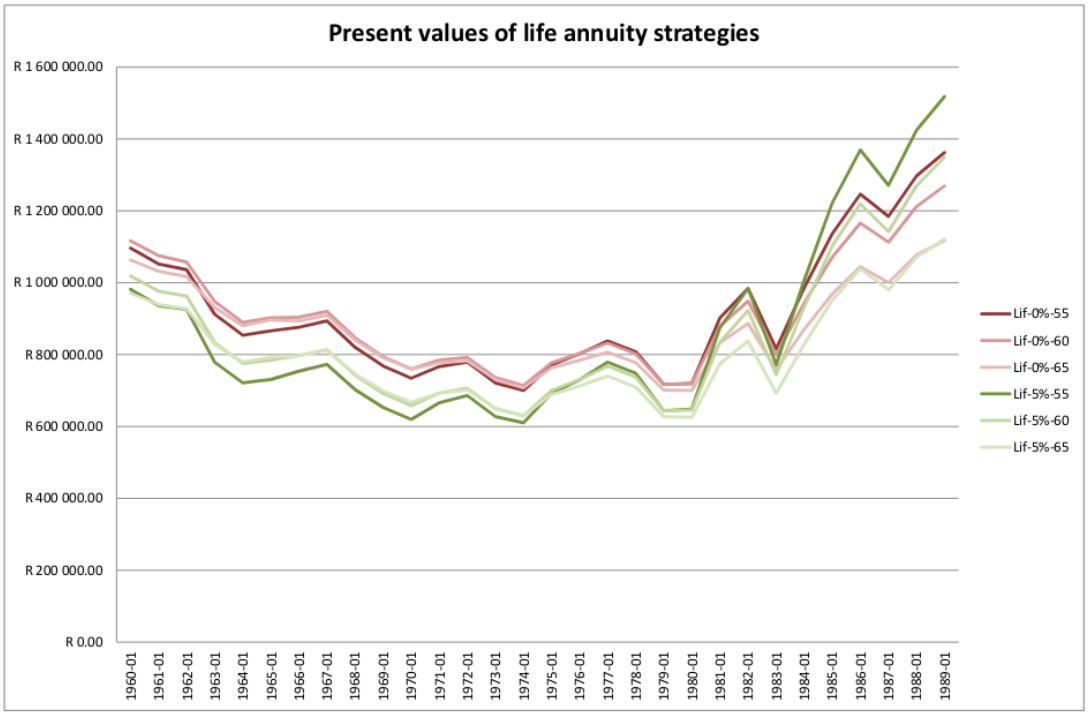

Figure 5.7: Present values of two life annuity strategies for male retirees aged 55, 60 and 65 respectively

Source: Author, 2012.

It is evident from the graph in Figure 5.7 that the level life annuity strategies (depicted by the purple lines) are superior to the life annuities increasing by 5% each year (depicted by the green lines) from 1960 until the early 1980s. This main trend could be explained by the fact that the life annuity rates are very low for annuities increasing by 5% each year, compared to the life annuity rates for level life annuities, as life insurers make provision for the annual increases to be paid to annuitants up until their death.

From the early 1980s, however, life annuities increasing by 5% each year seem to outperform level life annuities.

This can be explained by the fact that annuity rates are mainly dependent on the interest rates at date of purchase, as the underlying assets of life annuities are usually fixed interest government bonds. If interest rates are high, annuity rates offered on newly issued annuities are correspondingly high. From the early 1990s up until 2005 interest rates were exceptionally high as a result of monetary policy tightening. Therefore, the life annuities increasing by 5% each year started off at a high level, and increased even further by 5% each year up until the death of the annuitant.

The period of high interest rates therefore affected the values of life annuities increasing by

5% each year for all annuitants retiring in the early 1980s up until 1989, as the period of high interest rates is included in their retirement years.

5.2.3 Key performance indicators (KPIs)

Three of the four KPIs which were developed as measures by which living annuity strategies could be evaluated were used to evaluate life annuity strategies. These three KPIs are average rank, best rank and number of victories. Percentiles were not included as a KPI, as there are only two options to consider.

The results for the KPIs for a male retiree aged 55, 60 and 65 respectively are summarised in Table 5.4. In Figure 5.8 a graphical representation of the average rank KPI for male retirees aged 55, 60 and 65 respectively is given. A discussion regarding each of the KPIs for male retirees aged 55, 60 and 65 respectively follows in Section 5.2.3.1 to 5.2.3.2. In Section 5.2.3.3 the life annuity strategies' overall rank is discussed. It must be noted that both options were sorted by average rank.

Table: 5.4: Two life annuity strategies ranked by average rank for male retirees aged 55, 60 and 65 respectively

Retirement age 55				
Overall rank	Option	Average rank	Best rank	NOV
1	Lif-0%-55	1.23	1	23
2	Lif-5%-55	1.77	1	7

Retirement age 60				
Overall rank	Option	Average rank	Best rank	NOV
1	Lif-0%-60	1.17	1	25
2	Lif-5%-60	1.83	1	5

Retirement age 65				
Overall rank	Option	Average rank	Best rank	NOV
1	Lif-0%-65	1.03	1	29
2	Lif-5%-65	1.97	1	1

Source: Author, 2012.

5.2.3.1 Average rank

Average rank for two life annuity strategies was calculated by firstly ranking the strategies' present values for each year (from 1960 to 1989) from one (the best) to two (the worst). The

average rank for each strategy was then calculated by adding the rankings for each year from 1960 to 1989, and by then dividing the total by 30 (number of years from 1960 to 1989) (see Formula 5.1 in Section 5.1.3.1).

The average rank for two life annuity strategies is also schematically illustrated in Figure 5.8.

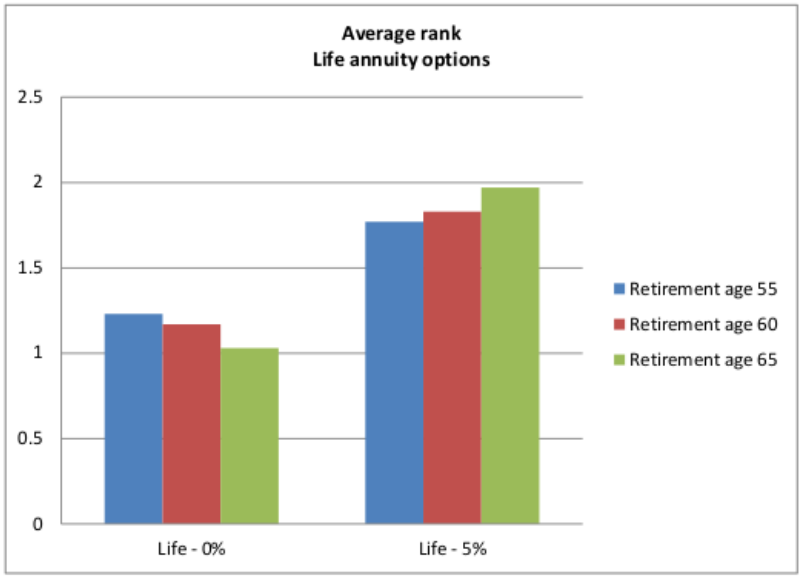

Figure: 5.8: Average rank for two life annuity strategies for male retirees aged 55, 60 and 65 respectively

Source: Author, 2012.

According to this KPI, a level life annuity would have provided a 55, 60 and 65-year-old male respectively with better financial benefits than a 5% life annuity in terms of present value.

5.2.3.2 Best rank and number of victories (NOV)

Best rank refers to the best rank awarded to two life annuity strategies over 30 years from 1960 to 1989. NOV refers to the number of times a strategy was the best strategy for a single year. These indicators, however, do not carry significant weight and were merely included as a matter of interest.

According to the NOV KPI, a level life annuity was the best strategy for 23 out of 30 times for a male aged 55, 25 out of 30 times for a male aged 60 and 29 out of 30 times for a male aged 65.

5.2.3.3 Overall rank

The two life annuity strategies were ranked from one (the best performer) to two (the worst performer) according to their respective average ranking over the 30 years from 1960 to 1989 for a male retiree aged 55, 60 and 65 respectively.

According to this KPI, a level life annuity was the overall winner for all age groups.

5.3 Composite annuity strategies

In Section 5.3.1 background information on 18 composite annuity strategies (nine previously mentioned living annuity strategies combined with two life annuity strategies) is given. In Section 5.3.2 KPIs are presented and discussed in order to facilitate the evaluation and comparison of the 18 composite annuity strategies. This is followed by a direct comparison of pure living annuity strategies with composite annuity strategies in Section 5.3.3.

5.3.1 Background information on 18 composite annuity strategies

For ease of reference a brief synopsis of Section 4.2.3 is provided in this section.

For male annuitants retiring at ages 55, 60 and 65 respectively during the period 1960 to 1989, the present values of the monthly cash flows provided by composite annuity strategies with a 50/50 split between a life and a living annuity strategy were calculated.

The present values of cash flows were calculated per R1 million invested. The present value of the remaining capital at death was also included.

The discount rate used to discount the annuities for a cash flow in month n, was the geometric average of the inflation rates through months one to n (see numerical example 3 in Table 4.4).

It was assumed that the males (aged 55, 60 and 65) retired every year, at the beginning of that year, during the period 1960 to 1989, and that their life expectancy was that of the a (55) life mortality table as published by the Cambridge University Press in 1953 (Botha *et al.*, 2011: 1056) (see discussion in Section 4.2.1).

As this study is based on historical data available up to December 2010, a sub-period of 30 years was used (1960 to 1989) to ensure that the time period includes the expected date of decease of a male.

Each life annuity strategy was combined with each living annuity strategy (see Section 5.1.1 and Section 5.2.1).

There were 1620 combinations (nine living annuity strategies combined with two life annuity strategies for three retirement ages over 30 years) as shown in Appendix A, Table A.3.

5.3.2 Key performance indicators (KPIs)

As for the previously evaluated annuity strategies, the same four KPIs were developed as measures by which composite annuity strategies could be evaluated. KPIs include average rank, best rank, number of victories and percentiles.

The results for the KPIs for male retirees aged 55, 60 and 65 respectively are summarised in Table 5.5 to Table 5.7. In Figure 5.9 to Figure 5.11 a graphical representation of the average rank KPI for male retirees aged 55, 60 and 65 respectively is given. A discussion of each of the KPIs for male retirees aged 55, 60 and 65 respectively follows in Section 5.3.2.1 to 5.3.2.3. In Section 5.1.3.4 the life annuity strategies' overall rank is discussed. It must be noted that all options were sorted by average rank in the tables.

Table 5.5: 18 composite annuity strategies ranked by KPIs for a male retiree aged 55

Retirement age 55					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	C[Liv-C-b-55-0%]	2.63	1	9	100%	100%	93%	80%
2	C[Liv-C-b-55-5%]	3.87	1	3	100%	97%	97%	50%
3	C[Liv-C-a-55-0%]	4.57	1	10	93%	83%	77%	63%
4	C[Liv-C-a-55-5%]	5.43	3	0	100%	97%	87%	17%
5	C[Liv-C-c-55-0%]	5.57	1	4	90%	83%	80%	47%
6	C[Liv-C-c-55-5%]	6.53	3	0	97%	97%	73%	3%
7	C[Liv-B-b-55-0%]	7.20	3	0	100%	90%	50%	3%
8	C[Liv-B-b-55-5%]	8.97	1	4	97%	50%	30%	23%
9	C[Liv-B-a-55-0%]	9.33	7	0	97%	80%	20%	0%
10	C[Liv-B-c-55-0%]	9.83	3	0	87%	60%	33%	3%
11	C[Liv-B-a-55-5%]	10.63	6	0	100%	53%	7%	0%
12	C[Liv-B-c-55-5%]	11.13	5	0	97%	23%	10%	0%
13	C[Liv-A-b-55-0%]	12.67	5	0	60%	20%	13%	0%
14	C[Liv-A-c-55-0%]	13.03	4	0	57%	33%	7%	0%
15	C[Liv-A-b-55-5%]	13.73	2	0	30%	20%	20%	10%
16	C[Liv-A-c-55-5%]	14.37	8	0	57%	10%	0%	0%
17	C[Liv-A-a-55-0%]	15.37	11	0	20%	0%	0%	0%
18	C[Liv-A-a-55-5%]	16.13	7	0	20%	3%	3%	0%

Source: Author, 2012.

Table: 5.6: 18 composite annuity strategies ranked by KPIs for a male retiree aged 60

Retirement age 60					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	C[Liv-C-b-60-0%]	3.10	1	12	100%	93%	90%	77%
2	C[Liv-C-a-60-0%]	4.20	1	12	87%	83%	83%	70%
3	C[Liv-C-b-60-5%]	4.83	1	2	100%	93%	87%	37%
4	C[Liv-C-c-60-0%]	5.10	1	1	90%	87%	83%	53%
5	C[Liv-C-a-60-5%]	5.63	2	0	97%	90%	87%	17%
6	C[Liv-C-c-60-5%]	6.77	4	0	93%	93%	83%	0%
7	C[Liv-B-b-60-0%]	7.80	3	0	100%	77%	53%	7%
8	C[Liv-B-c-60-0%]	8.87	2	0	97%	73%	37%	7%
9	C[Liv-B-a-60-0%]	9.23	7	0	97%	80%	13%	0%
10	C[Liv-B-b-60-5%]	9.77	1	1	97%	53%	20%	13%
11	C[Liv-B-c-60-5%]	10.70	6	0	100%	47%	3%	0%
12	C[Liv-B-a-60-5%]	11.10	7	0	100%	37%	3%	0%
13	C[Liv-A-c-60-0%]	12.00	4	0	73%	33%	10%	0%
14	C[Liv-A-b-60-0%]	12.63	2	0	53%	17%	17%	7%
15	C[Liv-A-c-60-5%]	13.87	8	0	60%	13%	0%	0%
16	C[Liv-A-b-60-5%]	14.33	1	2	23%	17%	17%	10%
17	C[Liv-A-a-60-0%]	14.87	4	0	17%	7%	7%	0%
18	C[Liv-A-a-60-5%]	16.20	3	0	17%	7%	7%	3%

Source: Author, 2012.

Table 5.7: 18 composite annuity strategies ranked by KPIs for a male retiree aged 65

Retirement age 65					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	C[Liv-C-b-65-0%]	3.27	1	11	100%	93%	90%	77%
2	C[Liv-C-a-65-0%]	3.60	1	8	93%	93%	87%	80%
3	C[Liv-C-c-65-0%]	4.17	1	7	90%	90%	87%	60%
4	C[Liv-C-b-65-5%]	5.97	2	0	97%	87%	83%	20%
5	C[Liv-C-a-65-5%]	6.23	2	0	93%	87%	80%	13%
6	C[Liv-C-c-65-5%]	6.70	4	0	90%	87%	87%	0%
7	C[Liv-B-c-65-0%]	7.73	2	0	100%	83%	47%	10%
8	C[Liv-B-b-65-0%]	7.83	1	2	100%	80%	50%	7%
9	C[Liv-B-a-65-0%]	8.57	5	0	100%	90%	17%	0%
10	C[Liv-B-b-65-5%]	10.67	2	0	93%	47%	10%	7%
11	C[Liv-B-c-65-5%]	10.77	5	0	97%	47%	3%	0%
12	C[Liv-A-c-65-0%]	11.47	3	0	83%	37%	10%	3%
13	C[Liv-B-a-65-5%]	11.50	7	0	90%	27%	3%	0%
14	C[Liv-A-b-65-0%]	12.83	1	1	50%	13%	13%	10%
15	C[Liv-A-c-65-5%]	14.13	7	0	60%	10%	7%	0%
16	C[Liv-A-a-65-0%]	14.23	2	0	33%	10%	7%	3%
17	C[Liv-A-b-65-5%]	15.03	1	1	17%	13%	13%	7%
18	C[Liv-A-a-65-5%]	16.30	3	0	13%	7%	7%	3%

Source: Author, 2012.

5.3.2.1 Average rank

Average rank for 18 composite annuity strategies was calculated by firstly ranking the strategies' present values for each year (from 1960 to 1989) from one (the best) to 18 (the worst). The average rank for each strategy was then calculated by adding the rankings for each year and by then dividing the total by 30 (number of years from 1960 to 1989) (see Formula in Section 5.1.3.1).

The average rank for the 18 composite annuity strategies is also schematically illustrated for a male aged 55, 60 and 65 respectively, in Figure 5.9 to Figure 5.11.

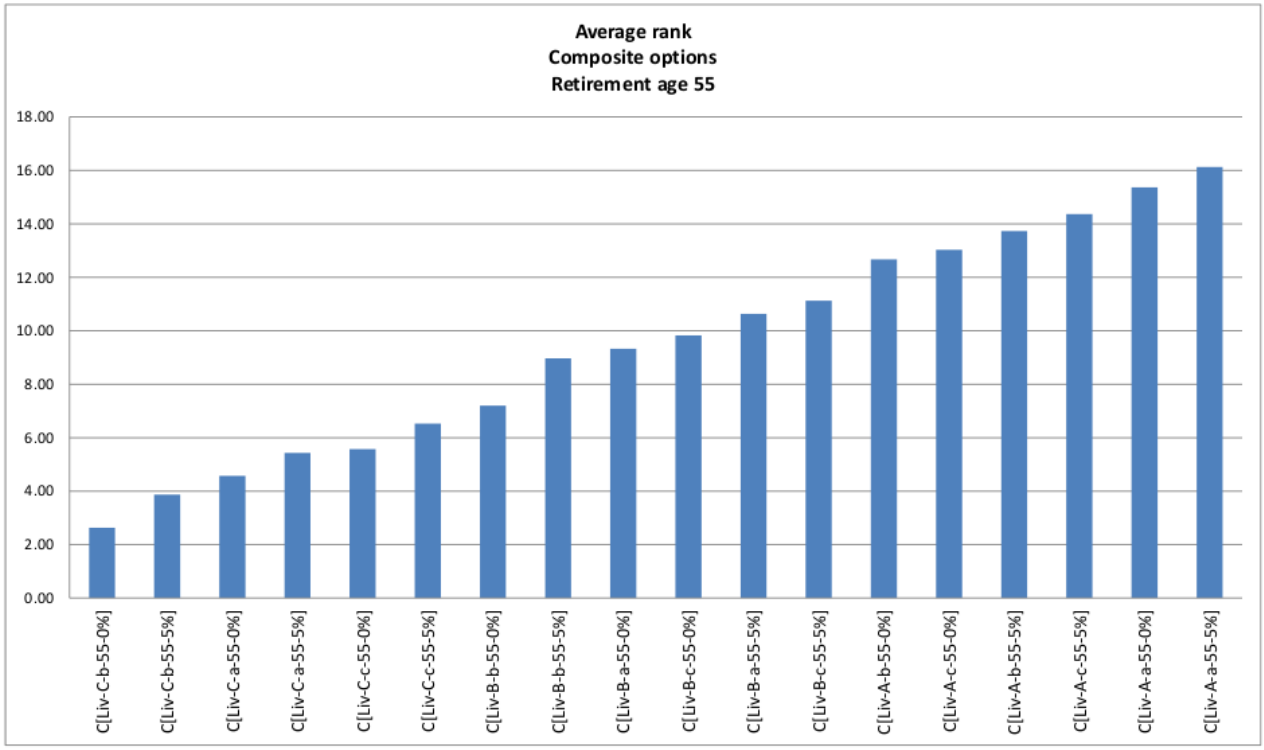

Figure 5.9: Average rank for 18 composite annuity strategies for a male retiree aged 55

Source: Author, 2012.

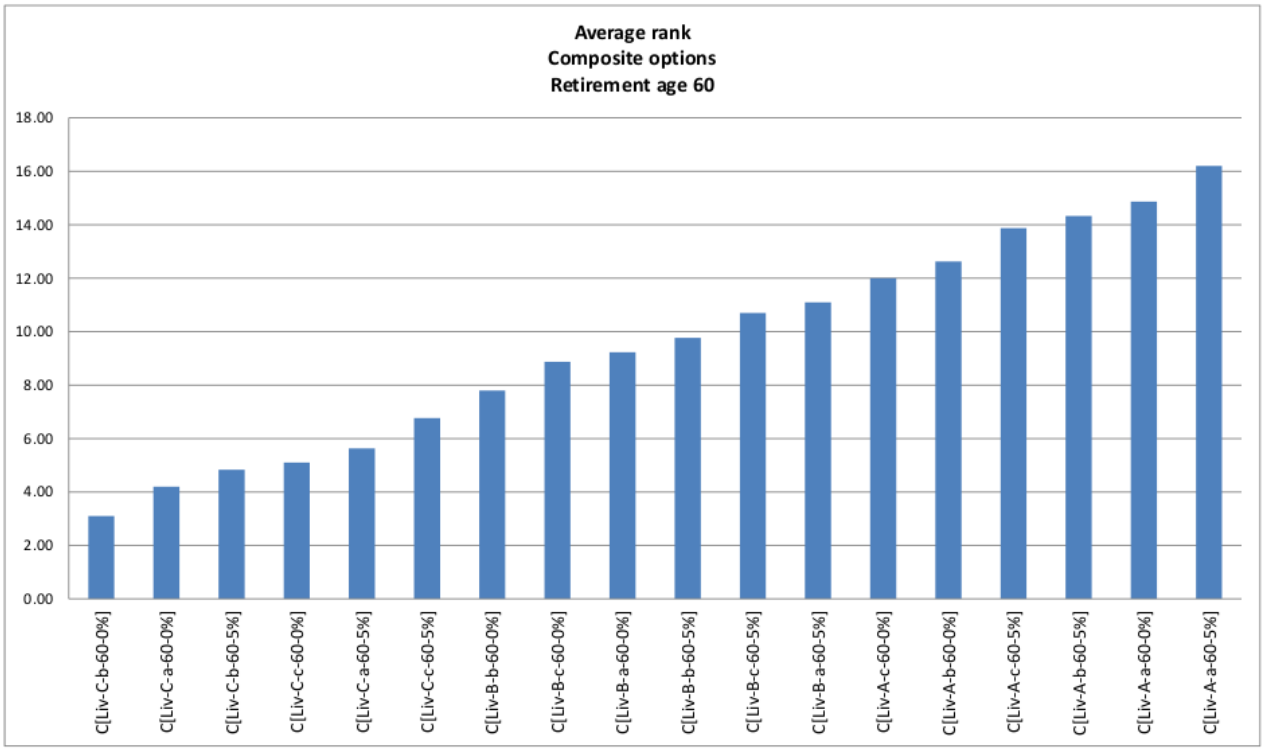

Figure 5.10: Average rank for 18 composite annuity strategies for a male retiree aged 60

Source: Author, 2012.

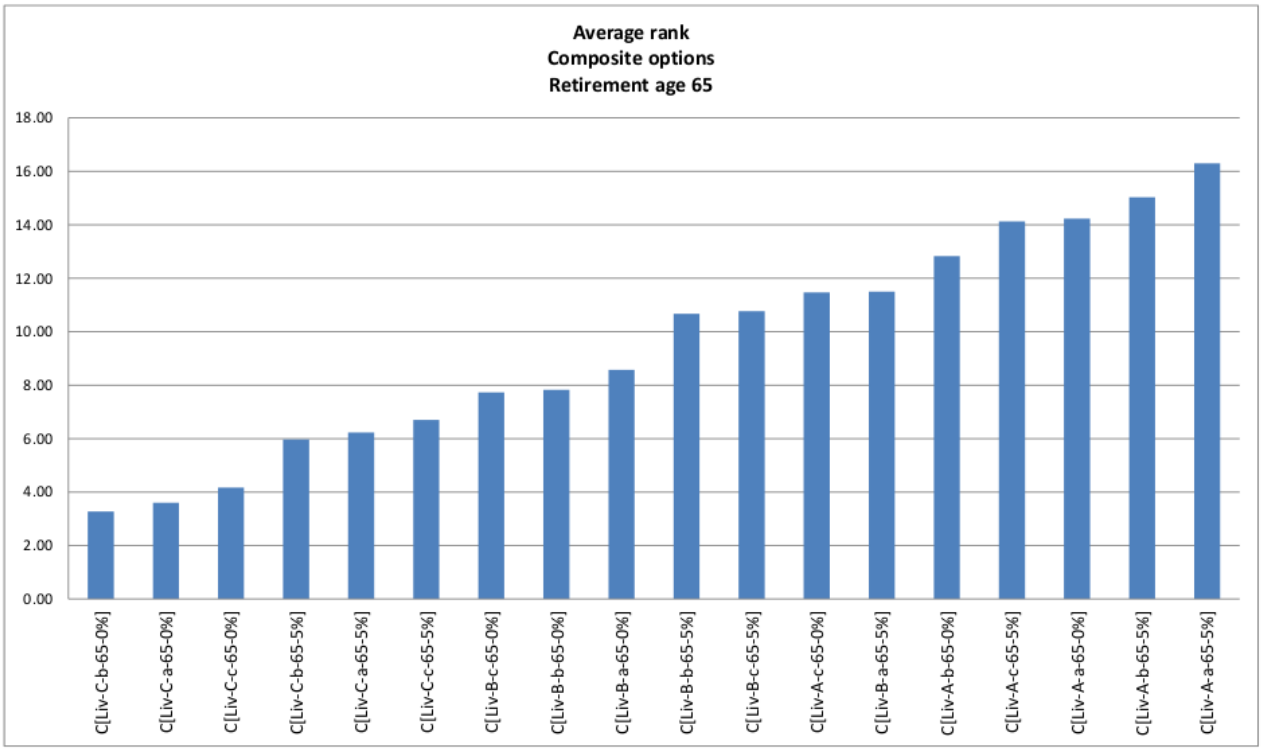

Figure 5.11: Average rank for 18 composite annuity strategies for a male retiree aged 65

Source: Author, 2012.

a) **For a male retiree aged 55**
According to this KPI, living annuity strategies with 75% invested in equity outperformed the strategies with less exposure to equity (50% or 25% invested in equity), irrespective of the drawdown strategy or life annuity chosen. Drawdown strategy b seems to outperform the other drawdown strategies for all asset allocations. The results also demonstrate that it was always best to combine a living annuity with a level life annuity, as opposed to combining with an annuity that increases by 5% each year, irrespective of the asset allocation and drawdown rate chosen.

b) **For a male retiree aged 60**
Similarly, according to this KPI, living annuity strategies with the maximum exposure to equity outperformed the strategies with less equity exposure, irrespective of the drawdown option or life annuity chosen. In the same fashion, drawdown strategy b was superior for aggressive and moderate asset allocations, whereas drawdown option c outperformed the other drawdown strategies for a conservative risk profile. Moreover, the results show that it is best to combine a living annuity with a level life annuity, as opposed to a life annuity that increases by 5% each year, irrespective of the asset allocation and drawdown option chosen.

c) **For a male retiree aged 65**
In the same fashion, according to this KPI, living annuity strategies with asset allocation C outperformed the strategies with either asset allocation B or A, irrespective of the drawdown option or life annuity chosen, with one exception though. C(Liv-A-c-65-0%) outperformed C(Liv-B-a-65-5%). The difference in average rank, however, is insignificantly small. Also, drawdown strategy b seems to be the superior drawdown strategy for an aggressive risk profile, whereas drawdown strategy c was the superior drawdown option for asset allocations B and A. Moreover, the results show that it is always best to combine a living annuity with a level life annuity, as opposed to a life annuity that increases by 5% each year, irrespective of the asset allocation and drawdown rate chosen.

5.3.2.2 Best rank and number of victories (NOV)

Best rank refers to the best rank awarded to 18 composite annuity strategies over 30 years, from 1960 to 1989. NOV refers to the number of times a strategy was the best strategy for a single year. These indicators, however, do not carry significant weight and were merely included as a matter of interest.

a) **For a male retiree aged 55**
Surprisingly, although C[Liv-C-a-55-0%] has a poorer average rank than C[Liv-C-b-55-5%], the former, according to the NOV KPI, achieved first place 10 out of 30 times, whereas the latter achieved first place only 3 out of 30 times. This implies that for the remainder of the 20 years, C[Liv-C-a-55-0%] markedly underperformed relative to the other 17 strategies. C[Liv-C-b-55-0%] achieved first place for 9 years out of 30 years.

b) **For a male retiree aged 60**
According to the NOV KPI, C[Liv-C-b-60-0%] and C[Liv-C-a-60-0%] each achieved first place 12 out of 30 years.

Not surprisingly, the former has a slightly better average rank than the latter as drawdown strategy b generally outperformed drawdown strategy a.

c) **For a male retiree aged 65**
Also, according to the NOV KPI, C[Liv-C-b-65-0%] achieved first place 11 out of 30 times, C[Liv-C-a-65-0%] 8 out of 30 times and C[Liv-C-c-65-0%] 7 out of 30 times.

5.3.2.3 Percentiles

For each year (from 1960 to 1989) the 20th, 40th, 60th and 80th percentile of the present values for 18 composite annuity strategies were calculated. (For a full explanation see Section 5.1.3.3).

After the 20th, 40th, 60th and 80th percentiles had been calculated, the number of years for which each strategy's present value was above the 20th, 40th, 60th and 80th percentile was added. Subsequently the percentage of time each strategy was above the 20th, 40th, 60th and 80th percentile was calculated (see Formula 5.2 in Section 5.1.3.3).

For all age groups there was a good correlation between the average rank, best rank and NOV and the 80% percentile KPI.

5.3.2.4 Overall rank

The 18 composite annuity strategies were ranked from one (the best) to nine (the worst strategy) according to their average rank over the 30 years from 1960 to 1989 for male retirees aged 55, 60 and 65 respectively.

The overall best performers for the three retirement ages were as follows:

- Age 55: C[Liv-C-b-55-0%]
- Age 60: C[Liv-C-b-60-0%]
- Age 65: C[Liv-C-b-65-0%]

The overall worst performers for the three retirement ages were as follows:

- Age 55: C[Liv-A-a-55-5%]
- Age 60: C[Liv-A-a-60-5%]
- Age 65: C[Liv-A-a-65-5%]

5.3.3 Comparing pure living annuities with composite annuity strategies

To determine whether it was better for a retiree to choose a pure living annuity versus combining a living annuity with a level life annuity, the calculated present values for the 810 composite living annuity combinations (three drawdown strategies combined with three asset allocations for three retirement ages over 30 years of retirement dates combined with a level life annuity) were subtracted from the 810 corresponding present values for pure living annuities. Negative results for the above calculation would therefore imply that the composite strategy was better than the pure strategy and *vice versa*.

The results for the above calculation are shown in Appendix D, Table D.1, and resulted in 36 negative values and 774 positive values. This implies that for 96% (774/810) of the combinations a pure living annuity strategy would have outperformed a composite annuity strategy.

Similarly, to determine whether it was better for a retiree to choose a pure living annuity versus combining a living annuity with a life annuity increasing by 5% per year, the calculated present values for the 810 composite living annuity combinations (three drawdown strategies combined with three asset allocations for three retirement ages over 30 years of retirement dates combined with a life annuity increasing by 5% per year) were subtracted from the 810 corresponding present

values for pure living annuities. Negative results for the above calculation would therefore imply that the composite strategy was better than the pure strategy and *vice versa*.

The results for the above calculation are shown in Appendix D, Table D.2 and resulted in one negative value and 809 positive values. This implies that for more than 99% (809 / 810) of the combinations a pure living annuity strategy would have outperformed a composite annuity strategy.

5.4 Switching annuity strategies

In Section 5.4.1 background information on the 18 switching annuity strategies is given.
In Section 5.4.2 KPIs are presented and discussed in order to facilitate the evaluation and comparison of 18 switching annuity strategies. This is followed by a direct comparison of pure living annuity strategies with switching annuity strategies in Section 5.4.3.

5.4.1 Background information on 18 switching annuity strategies

For ease of reference a brief synopsis of Section 4.2.4 is provided in this section.

For male annuitants retiring at ages 55, 60 and 65 respectively during the period 1960 to 1989, the present values were calculated of the monthly cash flows provided by a living annuity, which had been switched to a life annuity ten years after the annuitant had retired, by using the remaining living annuity capital to purchase a life annuity at prevailing annuity rates.

From this point onwards, a switching annuity strategy is indicated by adding an S in front of a square bracket.

The present values of cash flows were calculated per R1 million invested.

The discount rate used to discount the annuities for a cash flow in month n, was the geometric average of the inflation rates through months one to n (see numerical example 4 in Table 4.5).

It was assumed that the males (aged 55, 60 and 65) retired every year, at the beginning of that year, during the period 1960 to 1989, and that their life expectancy was that of the a (55) life mortality table as published by the Cambridge University Press in 1953 (Botha *et al.*, 2011: 1056) (see discussion in Section 4.2.1).

As this study is based on historical data available up to December 2010, a sub-period of 30 years was used (1960 to 1989) to ensure that the time period includes the expected date of decease of a male.

Each living annuity strategy was switched to each life annuity strategy (see Section 5.1.1 and Section 5.2.1).

There were 1620 combinations (nine living annuity strategies switched to two life annuity strategies for three retirement ages over 30 years) as shown in Appendix A, Table A.4.

5.4.2 Key performance indicators (KPIs)

As for the previously evaluated annuity strategies, the same four KPIs were developed as measures by which switching annuity strategies could be evaluated. KPIs include average rank, best rank, number of victories and percentiles.

The results for the KPIs for male retirees aged 55, 60 and 65 respectively are summarised in Table 5.8 - 5.10. In Figure 5.12 - 5.14 a graphical representation of the average rank KPI for male retirees aged 55, 60 and 65 respectively is given. A discussion of each of the KPIs for male retirees aged 55, 60 and 65 respectively follows in Section 5.4.2.1 to 5.4.2.3. In Section 5.4.2.4 the life annuity strategies' overall rank is discussed. It must be noted that all options were sorted by average rank in the tables.

Table: 5.8: 18 switching annuity strategies ranked by average rank for a male retiree aged 55

Retirement age 55					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	S[Liv-C-b-55-0%]	2.40	1	10	100%	97%	93%	90%
2	S[Liv-C-a-55-0%]	2.83	1	13	100%	93%	93%	83%
3	S[Liv-C-c-55-0%]	3.50	1	3	93%	93%	93%	87%
4	S[Liv-C-a-55-5%]	5.97	4	0	93%	90%	83%	0%
5	S[Liv-C-b-55-5%]	6.10	2	0	97%	87%	87%	3%
6	S[Liv-C-c-55-5%]	6.73	3	0	90%	87%	87%	3%
7	S[Liv-B-b-55-0%]	7.00	1	2	100%	100%	60%	10%
8	S[Liv-B-c-55-0%]	7.83	1	1	100%	97%	30%	3%
9	S[Liv-B-a-55-0%]	8.00	2	0	100%	93%	37%	3%
10	S[Liv-B-b-55-5%]	10.70	8	0	100%	47%	0%	0%
11	S[Liv-B-a-55-5%]	11.10	6	0	93%	40%	3%	0%
12	S[Liv-B-c-55-5%]	11.20	4	0	93%	23%	3%	0%
13	S[Liv-A-b-55-0%]	12.47	1	1	73%	17%	10%	7%
14	S[Liv-A-c-55-0%]	12.93	3	0	77%	10%	7%	7%
15	S[Liv-A-a-55-0%]	14.23	2	0	43%	10%	3%	3%
16	S[Liv-A-c-55-5%]	15.70	6	0	23%	7%	3%	0%
17	S[Liv-A-b-55-5%]	15.73	5	0	17%	3%	3%	0%
18	S[Liv-A-a-55-5%]	16.57	6	0	7%	7%	3%	0%

Source: Author, 2012.

Table: 5.9: 18 switching annuity strategies ranked by average rank for a male retiree aged 60

Retirement age 60					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	S[Liv-C-b-60-0%]	2.77	1	9	97%	97%	93%	87%
2	S[Liv-C-c-60-0%]	2.90	1	4	100%	93%	93%	90%
3	S[Liv-C-a-60-0%]	3.03	1	13	100%	93%	90%	83%
4	S[Liv-C-a-60-5%]	6.17	4	0	93%	87%	80%	0%
5	S[Liv-C-c-60-5%]	6.23	3	0	93%	90%	87%	3%
6	S[Liv-C-b-60-5%]	6.57	3	0	93%	87%	83%	3%
7	S[Liv-B-c-60-0%]	6.97	1	1	100%	100%	60%	7%
8	S[Liv-B-b-60-0%]	7.37	1	1	100%	100%	53%	7%
9	S[Liv-B-a-60-0%]	8.27	1	1	100%	83%	23%	7%
10	S[Liv-B-c-60-5%]	10.37	4	0	93%	53%	7%	0%
11	S[Liv-B-b-60-5%]	11.20	9	0	100%	37%	0%	0%
12	S[Liv-B-a-60-5%]	11.57	8	0	87%	23%	0%	0%
13	S[Liv-A-c-60-0%]	12.27	3	0	93%	17%	7%	7%
14	S[Liv-A-b-60-0%]	12.87	1	1	57%	17%	10%	3%
15	S[Liv-A-a-60-0%]	14.50	2	0	37%	10%	7%	3%
16	S[Liv-A-c-60-5%]	14.97	6	0	40%	7%	3%	0%
17	S[Liv-A-b-60-5%]	16.03	8	0	10%	3%	0%	0%
18	S[Liv-A-a-60-5%]	16.97	7	0	7%	3%	3%	0%

Source: Author, 2012.

Table: 5.10: 18 switching annuity strategies ranked by average rank for a male retiree aged 65

Retirement age 65					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	S[Liv-C-c-65-0%]	1.77	1	14	100%	100%	100%	93%
2	S[Liv-C-a-65-0%]	4.17	1	6	97%	90%	80%	63%
3	S[Liv-C-c-65-5%]	4.40	2	0	100%	100%	93%	37%
4	S[Liv-C-b-65-0%]	4.67	1	6	97%	90%	87%	33%
5	S[Liv-B-c-65-0%]	5.57	1	3	100%	100%	77%	30%
6	S[Liv-C-a-65-5%]	7.37	3	0	97%	80%	63%	20%
7	S[Liv-C-b-65-5%]	7.73	3	0	87%	77%	63%	13%
8	S[Liv-B-c-65-5%]	7.97	4	0	100%	90%	43%	0%
9	S[Liv-B-b-65-0%]	8.90	5	0	100%	73%	33%	0%
10	S[Liv-B-a-65-0%]	10.03	4	0	87%	60%	20%	0%
11	S[Liv-A-c-65-0%]	10.13	1	1	90%	47%	20%	10%
12	S[Liv-B-b-65-5%]	11.73	7	0	83%	33%	3%	0%
13	S[Liv-A-c-65-5%]	12.40	5	0	77%	27%	10%	0%
14	S[Liv-B-a-65-5%]	13.10	9	0	70%	10%	0%	0%
15	S[Liv-A-b-65-0%]	13.23	8	0	53%	13%	0%	0%
16	S[Liv-A-a-65-0%]	15.10	4	0	23%	10%	7%	0%
17	S[Liv-A-b-65-5%]	15.43	11	0	37%	0%	0%	0%
18	S[Liv-A-a-65-5%]	17.30	13	0	3%	0%	0%	0%

Source: Author, 2012.

5.4.2.1 Average rank

Average rank for 18 switching annuity strategies was calculated by firstly ranking the strategies' present values for each year (from 1960 to 1989) from one (the best) to 18 (the worst). The average rank for each strategy was then calculated by adding the rankings for each year and by then dividing the total by 30 (number of years from 1960 to 1989). See Formula 5.1 in Section 5.1.3.1. The average rank for the 18 composite annuity strategies is also schematically illustrated for a male aged 55, 60 and 65 respectively, in Figure 5.12 to Figure 5.14.

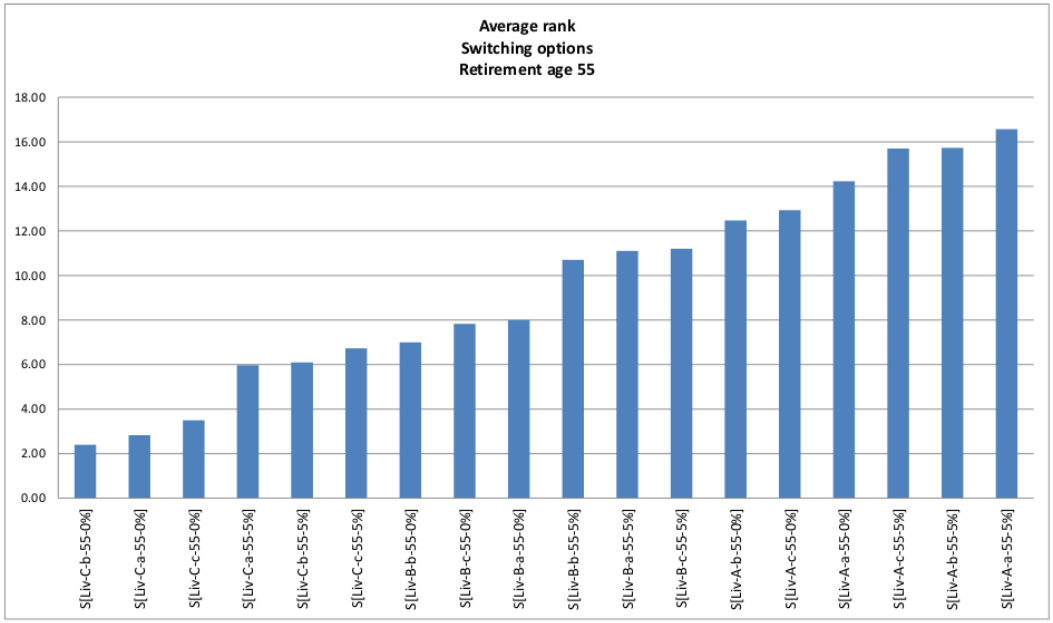

Figure 5.12: Average rank for 18 switching annuity strategies for a male retiree aged 55

Source: Author, 2012.

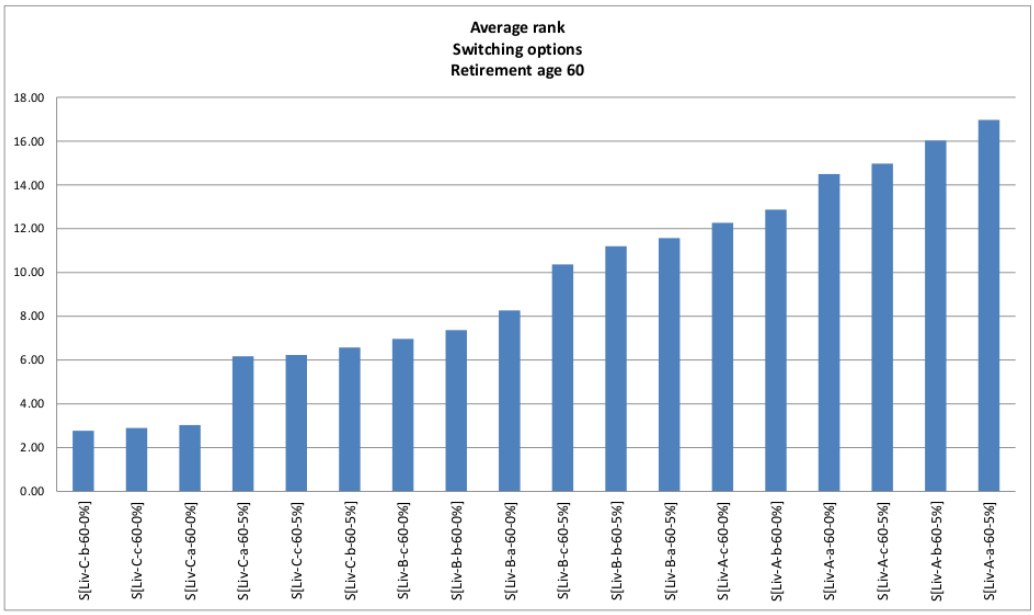

Figure 5.13: Average rank for 18 switching annuity strategies for a male retiree aged 60 **Source: Author, 2012.**

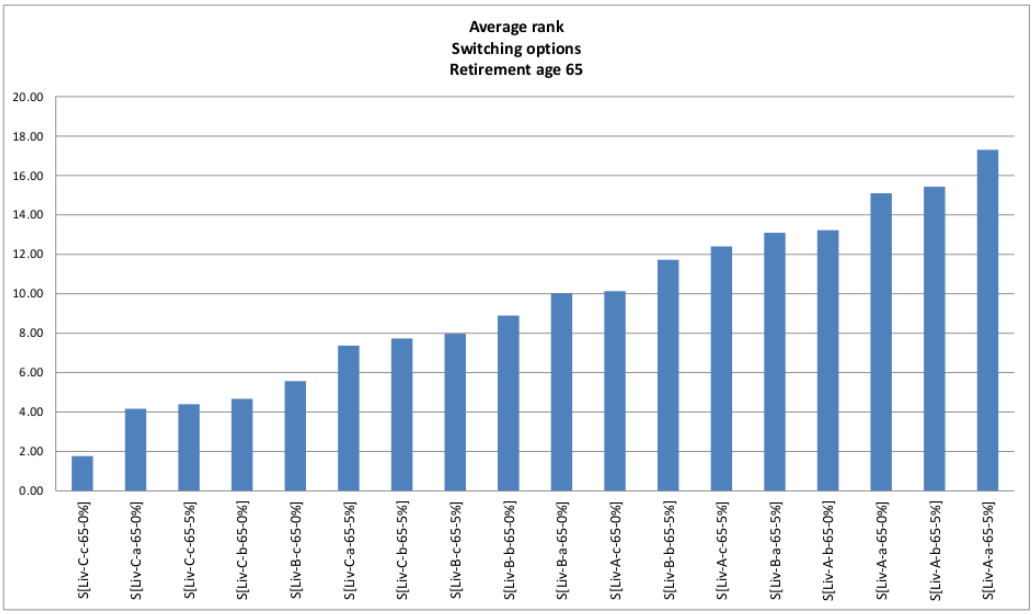

Figure 5.14: Average rank for 18 switching annuity strategies for a male retiree aged 65 **Source: Author, 2012.**

a) **For a male retiree aged 55**

According to this KPI, switching annuity strategies with 75% invested in equity outperformed the strategies with less exposure to equity (50%, followed by 25% invested in equity), irrespective of the drawdown strategy or life annuity chosen. Drawdown strategy b seems to outperform drawdown strategies a and c for most asset allocations. The results also demonstrate that it was always best to switch from a living annuity to a level life annuity, irrespective of the asset allocation and drawdown rate chosen, as opposed to switching to a life annuity that increases by 5% each year.

b) **For a male retiree aged 60**

Similarly, according to this KPI, switching annuity strategies with the maximum exposure to equity outperformed the strategies with less equity exposure (asset allocation B followed by A), irrespective of the drawdown option or life annuity chosen. No drawdown strategy was superior to the other drawdown options for asset allocation C, whereas drawdown option c outperformed for asset allocations B and A. The results also show that it was best to switch from a living annuity, irrespective of the asset allocation and drawdown option chosen, to a level life annuity, as opposed to switching to a life annuity that increases by 5% each year.

c) **For a male retiree aged 65**

In the same fashion, according to this KPI, switching annuity strategies with asset allocation C generally outperformed the strategies with either asset allocation B or A, irrespective of the drawdown option or life annuity chosen, with a couple of exceptions though. The exceptions are of little significance, as the difference in average rankings is minimal. Also, drawdown strategy c seems to be superior to drawdown strategies b and a, for all asset allocations. The results, moreover, show that it is in all cases best to switch from a living annuity, irrespective of the asset allocation and drawdown rate chosen, to a level life annuity, as opposed to switching to a life annuity that increases by 5% each year.

5.4.2.2 Best rank and number of victories (NOV)

Best rank refers to the best rank awarded to 18 switching annuity strategies over 30 years, from 1960 to 1989. NOV refers to the number of times a strategy was the best strategy for a single year. These indicators, however, do not carry significant weight and were merely included as a matter of interest.

a) **For a male retiree aged 55**

S[Liv-C-b-55-0%] performed best 10 out of 30 years and S[Liv-C-a-55-0%] performed best for 13 out of 30 years. These two strategies also have the best average ranks.

b) **For a male retiree aged 60**

Surprisingly, although S[Liv-C-a-60-0%] has a poorer average rank than S[Liv-C-c-60-0%], the former, according to the NOV KPI, was awarded first place 13 out of 30 times, whereas the latter was the best strategy 4 out of 30 times. This implies that for the remainder of the 17 years, S[Liv-C-a-60-0%] markedly underperformed relative to the other 17 strategies.

c) **For a male retiree aged 65**

Similarly, according to the NOV KPI, S[Liv-C-c-65-0%] achieved first place 14 out of 30 times. Its average rank is significantly better than the next best strategy.

5.4.2.3 Percentiles

For each year (from 1960 to 1989) the 20th, 40th, 60th and 80th percentile of the present values for 18 switching annuity strategies were calculated. (For a full explanation see Section 5.1.3.3).

After the 20th, 40th, 60th and 80th percentiles had been calculated, the number of years for which each strategy's present value was above the 20th, 40th, 60th and 80th percentile was added. Subsequently the percentage of time each strategy was above the 20th, 40th, 60th and 80th percentile was calculated (see Formula 5.2 in Section 5.1.3.3).

For all age groups there was a good correlation between the average rank, best rank and NOV and the 80% percentile KPI.

5.4.2.4 Overall rank

The 18 switching annuity strategies were ranked from one (the overall winner) to nine (the worst strategy) according to their average ranking over the 30 years from 1960 to 1989 for a male retiree aged 55, 60 and 65 respectively.

The overall best performers for the three retirement ages were as follows:

- Age 55: S[Liv-C-b-55-0%]
- Age 60: S[Liv-C-b-60-0%]
- Age 65: S[Liv-C-c-65-0%]

The overall worst performers for the three retirement ages were as follows:

- Age 55: S[Liv-A-a-55-5%]
- Age 60: S[Liv-A-a-60-5%]
- Age 65: S[Liv-A-a-65-5%]

5.4.3 Comparing pure living annuities with switching annuity strategies

To determine whether it was better for a retiree to choose a pure living annuity versus switching to a level life annuity, the calculated present values for the 810 switching living annuity combinations (three drawdown strategies combined with three asset allocations for three retirement

ages over 30 years of retirement dates switching to a level life annuity) were subtracted from the 810 corresponding present values for pure living annuities. Negative results for the above calculation would therefore imply that the switching strategy was better than the pure strategy and *vice versa*.

The results for the above calculation are shown in Appendix E, Table E.1 and resulted in zero negative values, which imply that a pure living annuity strategy would always have outperformed a switching annuity strategy.

Similarly, to determine whether it was better for a retiree to choose a pure living annuity versus switching to a life annuity increasing by 5% per year, the calculated present values for the 810 switching living annuity combinations (three drawdown strategies combined with three asset allocations for three retirement ages over 30 years of retirement dates switching to a life annuity increasing by 5% per year) were subtracted from the 810 corresponding present values for pure living annuities. Negative results for the above calculation would therefore imply that the switching strategy was better than the pure strategy and *vice versa*.

The results for the above calculation are shown in Appendix E, Table E.1 and resulted in zero negative values, which imply that a pure living annuity strategy would always have outperformed a switching annuity strategy.

5.5 All annuity strategies

In Section 5.5.1 background information on all the annuity strategies is given. In Section 5.5.2 KPIs are presented and discussed in order to facilitate the evaluation and comparison of all annuity strategies.

5.5.1 Background information on all annuity strategies

For male annuitants retiring at ages 55, 60 and 65 respectively during the period 1960 to 1989, the present values were calculated of the monthly cash flows provided by:

- nine living annuity strategies (three drawdown strategies combined with three asset allocations),
- 18 composite annuity strategies (nine living annuity strategies combined with two life annuity strategies), and
- 18 switching annuity strategies (nine living annuity strategies combined with two life annuity strategies).

See Section 5.1.1 to Section 5.4.1 for background information on all strategies.

The present values of cash flows were calculated per R1 million invested.

The discount rate used to discount the annuities for a cash flow in month n, was the geometric average of the inflation rates through months one to n (see numerical example 4 in Table 4.5).

It was assumed that the males (aged 55, 60 and 65) retired every year, at the beginning of that year, during the period 1960 to 1989, and that their life expectancy was that of the a (55) life mortality table as published by the Cambridge University Press in 1953 (Botha *et al.*, 2011: 1056) (see discussion in Section 4.2.1).

As this study is based on historical data available up to December 2010, a sub-period of 30 years was used (1960 to 1989) to ensure that the time period includes the expected date of decease of a male.

There were 4230 combinations (nine living annuity strategies, two life annuity strategies, 18 composite annuity strategies, 18 switching annuity strategies for three retirement ages over 30 years) as shown in Appendix A, Table A.1 to Table A.4.

5.5.2 Key performance indicators (KPIs)

As for the previously evaluated annuity strategies, the same four KPIs were developed as measures by which all possible annuity strategies could be evaluated against each other. KPIs include average rank, best rank, number of victories, and percentiles.

The results for the KPIs for male retirees aged 55, 60 and 65 respectively are summarised in Table 5.11 to Table 5.13. In Figure 5.15 to Figure 5.17 a graphical representation of the average rank KPI for male retirees aged 55, 60 and 65 respectively is given. A discussion of each of the KPIs for male retirees aged 55, 60 and 65 respectively follows in Section 5.5.2.1 to Section 5.5.2.3. In Section 5.5.2.4 the annuity strategies' overall rank is discussed. It must be noted that all options were sorted by average rank in the tables.

Table: 5.11: All annuity strategies ranked by average rank for a male retiree aged 55

Retirement age 55					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	Liv-C-b-55	2.07	1	12	100%	100%	100%	97%
2	Liv-C-a-55	2.63	1	10	100%	100%	100%	100%
3	Liv-C-c-55	3.60	1	4	100%	100%	100%	97%
4	Liv-B-b-55	7.97	1	4	100%	100%	100%	50%
5	Liv-B-a-55	8.17	4	0	100%	100%	100%	57%
6	Liv-B-c-55	8.37	3	0	100%	100%	100%	60%
7	C[Liv-C-b-55-0%]	9.57	5	0	100%	100%	100%	57%
8	C[Liv-C-a-55-0%]	11.77	4	0	100%	100%	77%	53%
9	C[Liv-C-b-55-5%]	12.23	7	0	100%	100%	97%	10%
10	C[Liv-C-a-55-5%]	13.40	6	0	100%	100%	87%	30%
11	C[Liv-C-c-55-0%]	13.67	4	0	100%	97%	73%	37%
12	S[Liv-C-b-55-0%]	15.77	4	0	97%	87%	67%	33%
13	C[Liv-C-c-55-5%]	15.80	7	0	100%	100%	77%	10%
14	Liv-A-c-55	16.10	4	0	100%	87%	57%	43%
15	S[Liv-C-a-55-0%]	16.17	4	0	93%	80%	70%	37%
16	S[Liv-C-c-55-0%]	17.13	4	0	93%	83%	67%	30%
17	C[Liv-B-b-55-0%]	18.23	12	0	100%	100%	47%	0%
18	C[Liv-B-a-55-0%]	21.17	15	0	100%	97%	30%	0%
19	S[Liv-C-a-55-5%]	21.43	7	0	90%	77%	43%	20%
20	Liv-A-b-55	21.57	2	0	100%	53%	33%	30%
21	C[Liv-B-b-55-5%]	21.67	9	0	100%	83%	30%	3%
22	S[Liv-C-b-55-5%]	22.03	8	0	87%	77%	50%	7%
23	C[Liv-B-c-55-0%]	22.27	7	0	100%	83%	30%	3%
24	S[Liv-C-c-55-5%]	22.90	7	0	87%	77%	40%	7%
25	C[Liv-B-a-55-5%]	23.97	14	0	100%	80%	13%	0%
26	C[Liv-B-c-55-5%]	24.73	13	0	100%	67%	27%	0%
27	Liv-A-a-55	25.50	5	0	83%	47%	30%	27%
28	S[Liv-B-b-55-0%]	27.23	19	0	100%	57%	0%	0%
29	C[Liv-A-c-55-0%]	27.97	8	0	83%	50%	17%	3%
30	S[Liv-B-c-55-0%]	28.40	20	0	97%	47%	0%	0%
31	C[Liv-A-b-55-0%]	28.47	13	0	100%	37%	13%	0%
32	S[Liv-B-a-55-0%]	28.63	19	0	90%	50%	0%	0%
33	C[Liv-A-c-55-5%]	30.60	14	0	77%	40%	7%	0%
34	C[Liv-A-b-55-5%]	31.93	10	0	50%	33%	17%	0%
35	C[Liv-A-a-55-0%]	32.63	20	0	97%	27%	0%	0%
36	S[Liv-B-b-55-5%]	33.23	24	0	83%	10%	0%	0%
37	S[Liv-B-a-55-5%]	33.80	22	0	73%	20%	0%	0%
38	S[Liv-B-c-55-5%]	34.00	23	0	73%	20%	0%	0%
39	C[Liv-A-a-55-5%]	35.67	15	0	40%	20%	3%	0%
40	S[Liv-A-b-55-0%]	39.27	28	0	17%	3%	0%	0%
41	Lif-0%-55	39.47	19	0	37%	13%	0%	0%
42	S[Liv-A-c-55-0%]	39.48	30	0	17%	0%	0%	0%
43	S[Liv-A-a-55-0%]	41.47	29	0	13%	0%	0%	0%
44	S[Liv-A-c-55-5%]	43.23	35	0	7%	0%	0%	0%
45	S[Liv-A-b-55-5%]	43.27	32	0	3%	0%	0%	0%
46	S[Liv-A-a-55-5%]	44.40	33	0	7%	0%	0%	0%
47	Lif-5%-55	45.00	32	0	7%	0%	0%	0%

Source: Author, 2012.

Table: 5.12: All annuity strategies ranked by average rank for a male retiree aged 60

Retirement age 60					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	Liv-C-b-60	2.53	1	14	100%	100%	100%	97%
2	Liv-C-a-60	2.63	1	12	100%	100%	100%	100%
3	Liv-C-c-60	3.63	1	1	100%	100%	97%	97%
4	Liv-B-c-60	7.23	2	0	100%	100%	100%	70%
5	Liv-B-b-60	7.70	1	1	100%	100%	100%	57%
6	Liv-B-a-60	8.30	4	0	100%	100%	97%	70%
7	C[Liv-C-b-60-0%]	9.87	4	0	100%	100%	90%	67%
8	C[Liv-C-a-60-0%]	11.40	4	0	100%	97%	83%	57%
9	C[Liv-C-c-60-0%]	12.73	5	0	100%	93%	83%	40%
10	C[Liv-C-b-60-5%]	13.10	6	0	100%	100%	90%	10%
11	C[Liv-C-a-60-5%]	13.67	6	0	100%	97%	87%	30%
12	Liv-A-c-60	14.07	4	0	100%	93%	63%	37%
13	C[Liv-C-c-60-5%]	16.10	9	0	100%	100%	77%	7%
14	S[Liv-C-a-60-0%]	16.93	4	0	93%	80%	70%	27%
15	S[Liv-C-b-60-0%]	16.97	5	0	97%	87%	67%	27%
16	S[Liv-C-c-60-0%]	17.03	4	0	93%	83%	67%	20%
17	C[Liv-B-b-60-0%]	18.70	11	0	100%	100%	40%	0%
18	C[Liv-B-c-60-0%]	20.33	6	0	100%	97%	30%	7%
19	C[Liv-B-a-60-0%]	20.67	14	0	100%	97%	33%	0%
20	Liv-A-b-60	21.80	1	2	100%	57%	30%	27%
21	C[Liv-B-b-60-5%]	22.13	11	0	100%	93%	20%	0%
22	S[Liv-C-a-60-5%]	22.47	7	0	87%	73%	47%	13%
23	S[Liv-C-c-60-5%]	23.20	8	0	90%	80%	40%	3%
24	C[Liv-B-c-60-5%]	23.53	10	0	100%	80%	23%	0%
25	S[Liv-C-b-60-5%]	23.73	9	0	87%	77%	37%	3%
26	C[Liv-B-a-60-5%]	24.13	15	0	100%	77%	13%	0%
27	C[Liv-A-c-60-0%]	25.80	8	0	93%	63%	23%	7%
28	Liv-A-a-60	25.93	2	0	87%	37%	30%	23%
29	S[Liv-B-c-60-0%]	27.80	19	0	100%	47%	0%	0%
30	C[Liv-A-b-60-0%]	28.13	7	0	100%	43%	13%	3%
31	S[Liv-B-b-60-0%]	28.53	16	0	100%	50%	3%	0%
32	C[Liv-A-c-60-5%]	29.00	12	0	83%	43%	17%	0%
33	S[Liv-B-a-60-0%]	30.07	19	0	87%	37%	0%	0%
34	C[Liv-A-a-60-0%]	31.73	11	0	97%	27%	7%	0%
35	C[Liv-A-b-60-5%]	31.87	6	0	60%	23%	17%	3%
36	S[Liv-B-c-60-5%]	33.63	23	0	73%	17%	0%	0%
37	S[Liv-B-b-60-5%]	34.73	24	0	67%	7%	0%	0%
38	C[Liv-A-a-60-5%]	35.40	10	0	40%	17%	7%	0%
39	S[Liv-B-a-60-5%]	35.43	22	0	57%	13%	0%	0%
40	Lif-0%-60	38.43	19	0	40%	13%	0%	0%
41	S[Liv-A-c-60-0%]	39.20	30	0	23%	0%	0%	0%
42	S[Liv-A-b-60-0%]	40.13	28	0	13%	3%	0%	0%
43	S[Liv-A-a-60-0%]	42.37	29	0	10%	0%	0%	0%
44	S[Liv-A-c-60-5%]	42.60	35	0	7%	0%	0%	0%
45	Lif-5%-60	43.47	29	0	10%	0%	0%	0%
46	S[Liv-A-b-60-5%]	43.97	36	0	3%	0%	0%	0%
47	S[Liv-A-a-60-5%]	45.17	35	0	3%	0%	0%	0%

Source: Author, 2012.

Table: 5.13: All annuity strategies ranked by average rank for a male retiree aged 65

Retirement age 65					% years above percentile			
Overall rank	Option	Average rank	Best rank	NOV	20%	40%	60%	80%
1	Liv-C-a-65	2.67	1	8	100%	100%	100%	100%
2	Liv-C-b-65	2.70	1	11	100%	100%	100%	97%
3	Liv-C-c-65	2.93	1	7	100%	100%	100%	100%
4	Liv-B-c-65	5.23	2	0	100%	100%	100%	97%
5	Liv-B-b-65	6.30	1	2	100%	100%	100%	83%
6	Liv-B-a-65	6.73	3	0	100%	100%	100%	80%
7	C[Liv-C-b-65-0%]	9.90	4	0	100%	100%	93%	60%
8	C[Liv-C-a-65-0%]	9.97	4	0	100%	100%	90%	67%
9	C[Liv-C-c-65-0%]	10.90	5	0	100%	100%	87%	53%
10	Liv-A-c-65	11.00	3	0	100%	100%	90%	53%
11	C[Liv-C-b-65-5%]	13.53	7	0	100%	100%	90%	7%
12	C[Liv-C-a-65-5%]	13.77	8	0	100%	100%	87%	13%
13	C[Liv-C-c-65-5%]	14.40	8	0	100%	100%	87%	7%
14	C[Liv-B-c-65-0%]	16.60	6	0	100%	100%	50%	10%
15	C[Liv-B-b-65-0%]	16.93	10	0	100%	100%	73%	0%
16	C[Liv-B-a-65-0%]	18.00	13	0	100%	100%	57%	0%
17	Liv-A-b-65	19.10	1	2	100%	80%	40%	20%
18	S[Liv-C-c-65-0%]	20.10	5	0	100%	83%	43%	7%
19	C[Liv-B-c-65-5%]	20.70	9	0	100%	100%	27%	3%
20	C[Liv-B-b-65-5%]	21.30	11	0	100%	97%	20%	0%
21	C[Liv-B-a-65-5%]	22.47	16	0	100%	93%	17%	0%
22	C[Liv-A-c-65-0%]	22.67	7	0	100%	80%	37%	7%
23	Liv-A-a-65	23.07	2	0	93%	67%	30%	20%
24	S[Liv-C-a-65-0%]	23.57	4	0	87%	67%	40%	10%
25	S[Liv-C-b-65-0%]	24.53	7	0	87%	63%	33%	3%
26	S[Liv-C-c-65-5%]	25.37	14	0	93%	60%	27%	0%
27	C[Liv-A-b-65-0%]	25.93	10	0	97%	63%	13%	0%
28	C[Liv-A-c-65-5%]	26.60	11	0	100%	53%	10%	0%
29	C[Liv-A-a-65-0%]	28.50	11	0	100%	47%	7%	0%
30	S[Liv-C-a-65-5%]	29.37	6	0	73%	43%	23%	3%
31	S[Liv-B-c-65-0%]	29.50	22	0	93%	37%	0%	0%
32	S[Liv-C-b-65-5%]	29.90	15	0	77%	50%	10%	0%
33	C[Liv-A-b-65-5%]	30.63	10	0	77%	33%	13%	0%
34	S[Liv-B-c-65-5%]	33.00	25	0	90%	13%	0%	0%
35	C[Liv-A-a-65-5%]	33.20	12	0	63%	27%	7%	0%
36	Lif-0%-65	34.33	19	0	63%	20%	0%	0%
37	S[Liv-B-b-65-0%]	34.34	27	0	73%	7%	0%	0%
38	S[Liv-B-a-65-0%]	36.17	19	0	60%	7%	0%	0%
39	S[Liv-A-c-65-0%]	37.33	30	0	47%	0%	0%	0%
40	S[Liv-B-b-65-5%]	38.10	29	0	50%	0%	0%	0%
41	S[Liv-A-c-65-5%]	40.13	34	0	23%	0%	0%	0%
42	S[Liv-B-a-65-5%]	40.17	28	0	20%	7%	0%	0%
43	Lif-5%-65	41.23	28	0	17%	3%	0%	0%
44	S[Liv-A-b-65-0%]	41.37	37	0	10%	0%	0%	0%
45	S[Liv-A-a-65-0%]	43.70	33	0	7%	0%	0%	0%
46	S[Liv-A-b-65-5%]	43.90	40	0	0%	0%	0%	0%
47	S[Liv-A-a-65-5%]	46.17	42	0	0%	0%	0%	0%

Source: Author, 2012.

5.5.2.1 Average rank

Average rank for all annuity strategies was calculated by firstly ranking the strategies' present values for each year (from 1960 to 1989) from one (the best) to 47 (the worst). The average rank for each strategy was then calculated by adding the rankings for each year and by then dividing the total by 30 (number of years from 1960 to 1989) (see Formula 5.1 in Section 5.1.3.1).

The average rank for 47 annuity strategies is also schematically illustrated for a male aged 55, 60 and 65 respectively, in Figure 5.15 to Figure 5.17.

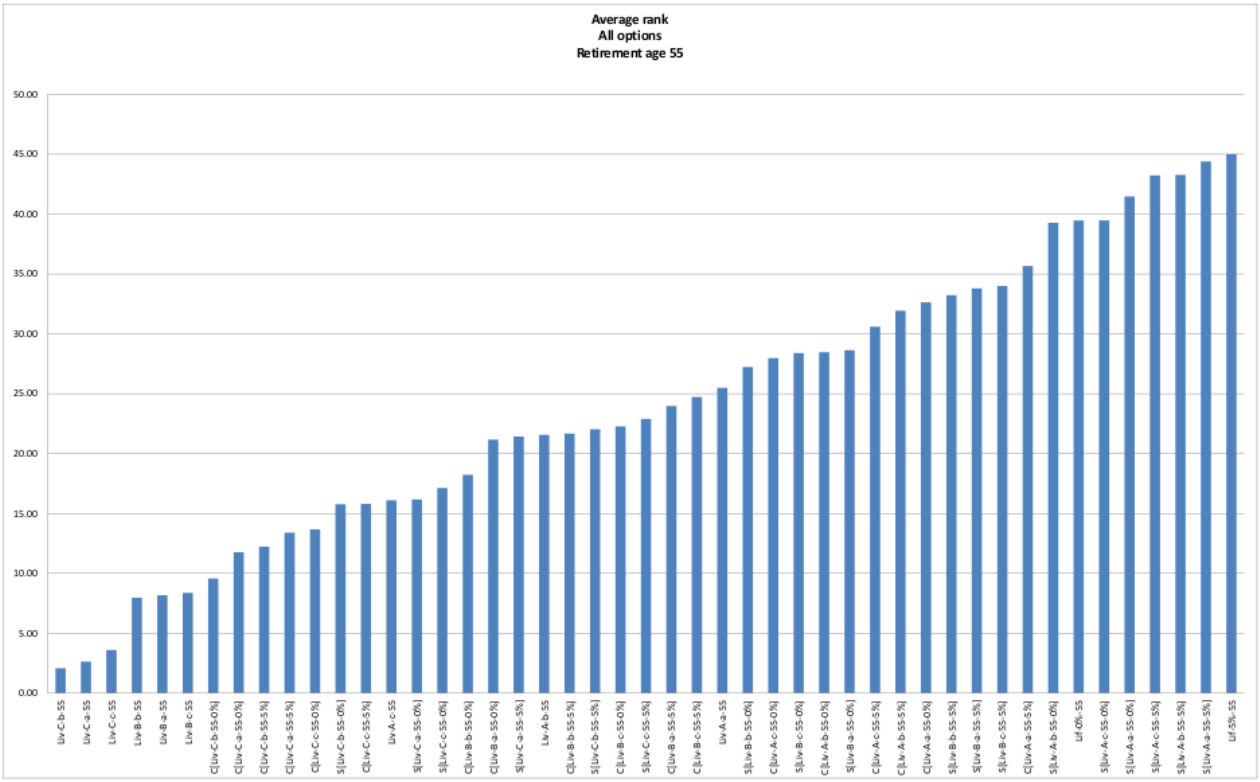

Figure 5.15: Average rank for all annuity strategies for a male retiree aged 55

Source: Author, 2012.

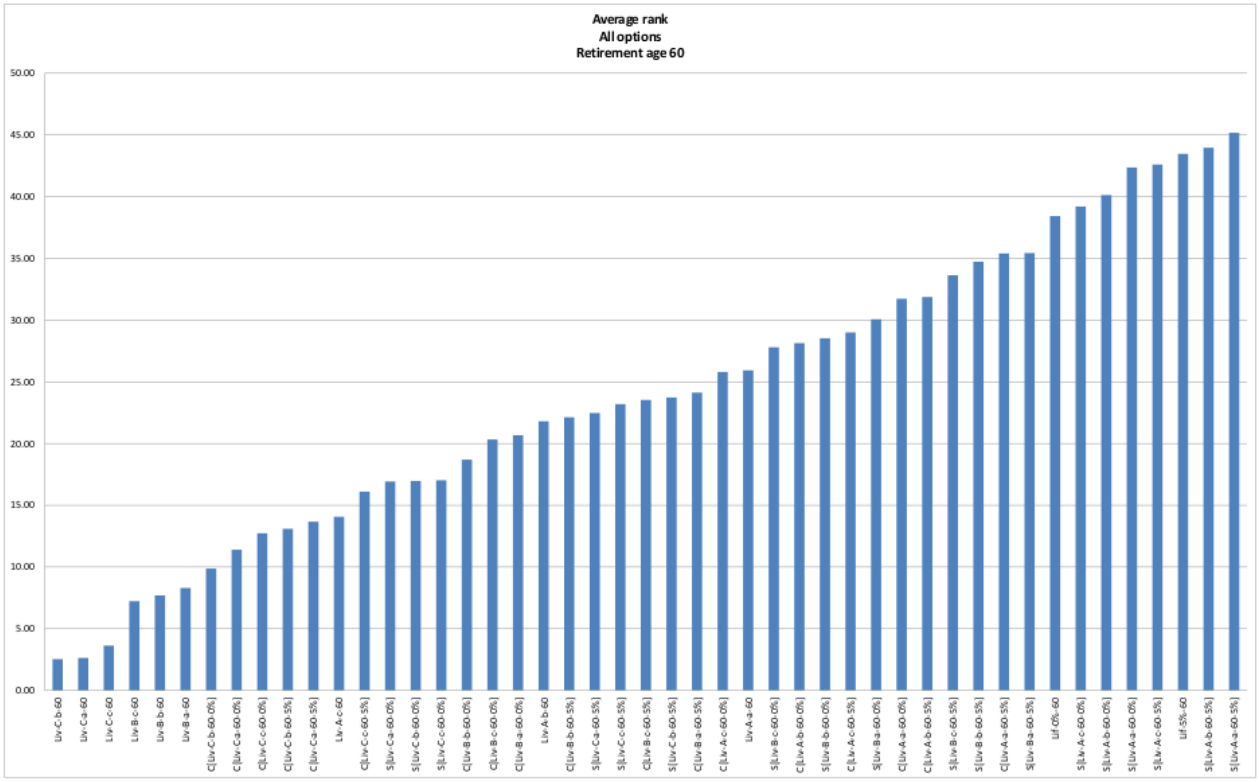

Figure 5.16: Average rank for all annuity strategies for a male retiree aged 60

Source: Author, 2012.

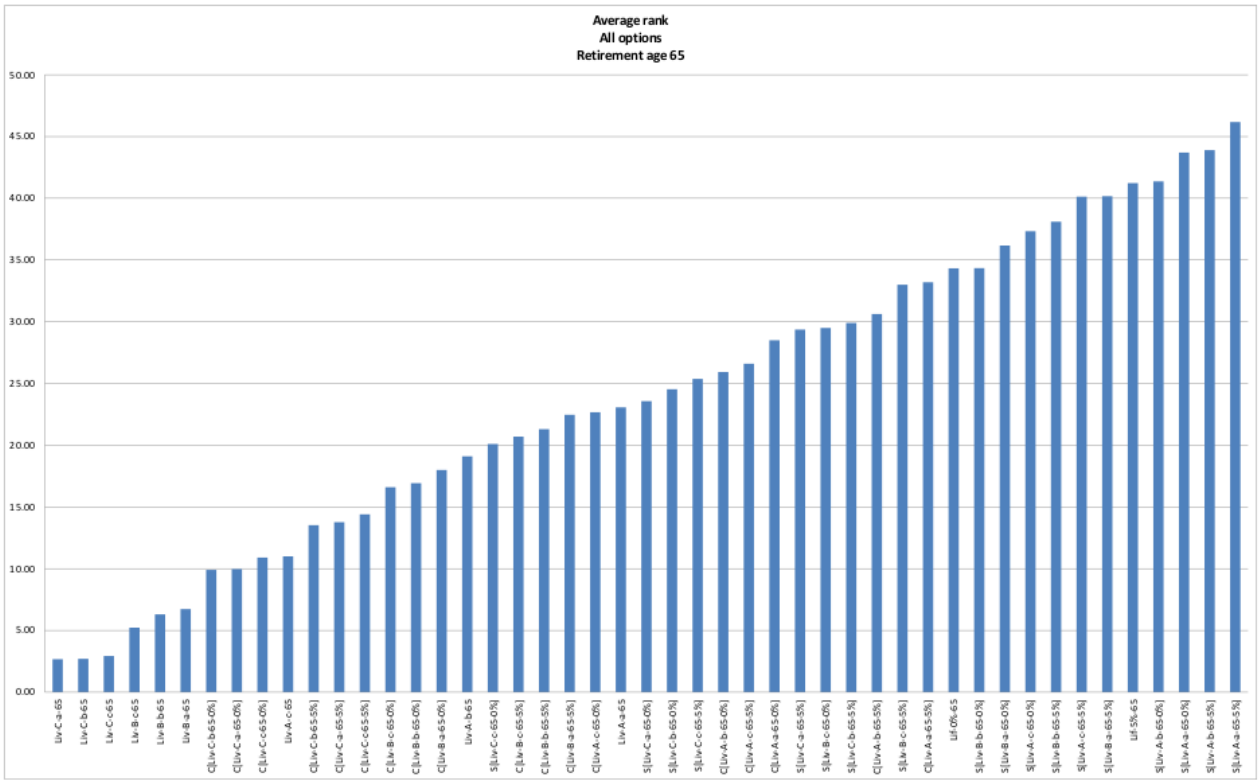

Figure 5.17: Average rank for all annuity strategies for a male retiree aged 65

Source: Author, 2012.

According to this KPI, it is evident that for all retirement ages, pure living annuity strategies generally outperform composite annuity strategies, which in turn generally outperform switching annuity strategies, with pure life annuity strategies as the worst performer.

5.5.2.2 Best rank and number of victories (NOV)

Best rank refers to the best rank awarded to 47 annuity strategies over 30 years, from 1960 to 1989. NOV refers to the number of times a strategy was the best strategy for a single year. These indicators, however, do not carry significant weight and were merely included as a matter of interest.

Liv-C-b-55 performed best 12 out of 30 years and Liv-C-a-55 performed best for 10 out of 30 years. Similarly, Liv-C-b-60 achieved first place for 14 out of 30 times, whereas Liv-C-a-60

achieved first place for 12 out of 30 times. Surprisingly, although Liv-C-b-65 has a poorer average rank than Liv-C-a-65, the former, according to the NOV KPI, was awarded first place 11 out of 30 times, whereas the latter was awarded first place for 8 out of 30 times. This implies that for the remainder of the 19 years, Liv-C-b-65 markedly underperformed relative to the other 46 strategies. It is interesting to note that pure living annuity strategies were the only strategies over the 30 years that achieved any victories. There were no victories for any composite, switching or pure life annuity strategies.

5.5.2.3 Percentiles

For each year (from 1960 to 1989) the 20th, 40th, 60th and 80th percentile of the present values for 47 annuity strategies were calculated. (For a full explanation see Section 5.1.3.3).

After the 20th, 40th, 60th and 80th percentiles had been calculated, the number of years for which each strategy's present value was above the 20th, 40th, 60th and 80th percentile was added. Subsequently the percentage of time each strategy was above the 20th, 40th, 60th and 80th percentile was calculated (see Formula 5.2 in Section 5.1.3.3).

According to this KPI for retirement age group 55, pure living annuity strategies with the maximum equity exposure outperformed 80% of the other strategies at least 97% of the time. The worst performing pure living annuity strategy (Liv-A-a-55) still managed to outperform 80% of the other strategies 27% of the time.

According to this KPI for retirement age group 60, pure living annuity strategies with the maximum equity exposure outperformed 80% of the other strategies at least 97% of the time. The worst performing pure living annuity strategy (Liv-A-a-60) still managed to outperform 80% of the other strategies 23% of the time.

According to this KPI for retirement age group 65, pure living annuity strategies with an aggressive or moderate risk profile, outperformed 80% of the other strategies at least 80% of the time. The worst performing pure living annuity strategy (Liv-A-a-65) still managed to outperform 80% of the other strategies 20% of the time.

5.5.2.4 Overall rank

The 47 annuity strategies were ranked from one (the overall winner) to 47 (the worst strategy) according to their average ranking over the 30 years from 1960 to 1989 for male retirees aged 55, 60 and 65 respectively.

The overall best performers for the three retirement ages were as follows:

- Age 55: Liv-C-b-55
- Age 60: Liv-C-b-60
- Age 65: Liv-C-a-65

The overall worst performers for the three retirement ages were as follows:

- Age 55: Lif-5%-55
- Age 60: S[Liv-A-a-60-5%]
- Age 65: S[Liv-A-a-65-5%]

Interestingly, the highest present value attained for a single year out of 4230 combinations tested, was for a male aged 55, retiring on 1 January 1977 and investing in a pure living annuity strategy with an aggressive asset allocation, and withdrawing annually an amount that increases the Rand amount of income by 5% per annum (see Appendix A, Table A.1).

Chapter 6

Conclusions, limitations and recommendations for future research

In Section 6.1, a conclusion is given of the results offered. Limitations of the study conducted in this thesis follow in Section 6.2. Finally, Section 6.3 concludes with areas of future research in this field.

6.1 Conclusions

The purpose of this study is to establish which of various annuity strategies would have been best to follow by male South Africans who retired in the 30 years from 1960 to 1989. To this end, the present values of the monthly cash flows provided by:

- nine living annuity strategies (three drawdown strategies combined with three asset allocations),
- two life annuity strategies,
- 18 composite annuity strategies (nine living annuity strategies combined with two life annuity strategies), and
- 18 switching annuity strategies (nine living annuity strategies switched to two life annuity strategies),

were calculated in this thesis in order to ascertain which strategy provided the largest financial benefits in present value terms.

It is evident from the results in Chapter 5 that pure living annuity strategies are superior to composite annuity strategies, which in turn outperform switching annuity strategies. A retiree would have been worst off if he invested all of his money in pure life annuities.

The above conclusion seems to be in contrast to international consensus, that retirees should invest, from a risk-return perspective (Dus *et al.*, 2005) at least a portion of their portfolio in life annuities. It was also suggested by Dus *et al.* (2005) that retirees with a low risk aversion should opt to either defer annuitisation until a later age, or they should consider an initial blending strategy where life annuities are combined with a phased withdrawal plan. According to many authors using a utility framework in order to compare annuitisation with self annuitisation, a large portion of wealth is optimally annuitised (Horneff *et al.*, 2008).

The above conclusion also seems to be in contrast with the findings of two recent South African studies.

In the study by Goemans and Ncube (2008), the authors came to the conclusion that retirees will only be able to obtain a level of income from a living annuity comparable to that of a life annuity, if they are willing to tolerate the disadvantage of a decreasing income stream.

In the study by Lodhia and Swanepoel (2012), the authors put forward that a life annuity is better equipped than a living annuity to provide a real income for life.

6.2 Limitations of the study

In contrast to the study conducted by Goemans and Ncube (2008), where risk is defined as the probability of a cash flow not meeting a certain minimum benchmark, no risk measure was used in this thesis, where the opinion is expressed that cash flows not meeting a certain minimum level as in the case of a life annuity benchmark, will be reflected in the present values of the various annuity strategies. However, one could, for example, incorporate an indicator, measuring the number of times a cash flow payment did not meet a certain benchmark level, after which the size of such shortfall could then be determined.

It should be noted that, for comparative purposes, living annuities were constructed as if they existed since 1960. Furthermore, with-profit as well as inflation-linked annuities were excluded from the study, due to their short history.

This thesis only considers data for specifically male retirees, and further investigation with respect to female retirees could prove fruitful. Also, extensions to added varieties of initial drawdown rates, drawdown strategies, as well as risk profiles, seem worthwhile to pursue.

The fact that an initial investment value of R1 million applied to all age groups (55, 60 and 65 years of age) limits the study, in that it does not mimic reality. A male retiring at the age of 65, as opposed to 55, would conceivably have a larger initial capital sum.

The performance of different annuity strategies, as measured according to historical data for a longer time span could better aid future retirees in selecting the most beneficial annuity strategies, as equity may not necessarily outperform bonds in future as theory suggests. In addition, a longer time span could prove more representative of the past and future.

In order to compare different annuity strategies, the present values of the monthly cash flows provided by these strategies were calculated. In using this method, the present values are very

sensitive with respect to the chosen discount rate. Hence, it could be worthwhile to pursue alternative discount rates, for example ruling long-term rates, to discount monthly cash flows.

6.3 Future research

According to a discussion paper published by National Treasury in September 2012 (National Treasury, 2012), legislation governing living annuities could dramatically change in the years to come. It would be interesting to investigate how these changes, if implemented, would have affected this study.

References

Albrecht, P. & Maurer, R. 2002. Self-annuitization, Consumption Shortfall in Retirement and Asset Allocation: The Annuity Benchmark. *Journal of Pension Economics and Finance*, 1(3): 269-288.

Association for Savings and Investment South Africa (ASISA). 2010. *Standard on Living Annuities*. (Online). Available: http://www.asisa.co.za/downloads/standards/2010/april/FINAL%20Standard%20on%20Living%20Annuities.pdf (30 September 2010).

Babbel, D.F. & Merrill, C. B. 2006. *Rational decumulation*. In: Working Paper, Wharton Financial Institutions Center (No. 2006 06-14).

Blake, D., Cairns, A.J.G. & Dowd, K. 2003. Pension Metrics II: Stochastic Pension Plan Design During the Distribution Phase. *Insurance: Mathematics and Economics*, 33(1): 29-47.

Botha, M., Rossini, L., Geach, W. & Goodall, B. 2009. *The South African Financial Planning Handbook 2010*. Durban: LexisNexis.

Botha, M., Rossini, L., Geach, W., Goodall, B. & Du Preez, L. 2011. *The South African Financial Planning Handbook 2012*. Durban: LexisNexis.

Brown, J. 2001. *The Role of Annuity Markets in Financing Retirement*. Cambridge: MIT Press.

Brown, J.R., Mitchell, O.S. & Poterba, J.M. 2001. The role of real annuities and indexed bonds in an individual accounts retirement program. In: *Risk Aspects of Investment-Based Social Security Reform*. Chicago: University of Chicago Press.

Browne, S., Milevsky, M.A. & Salisbury, T.S. 2003. Asset allocation and the liquidity premium for illiquid annuities. *Journal of Risk and Insurance*, 70(3): 509-526.

Business Dictionary. 2012a. *Percentiles*. (Online). Available: http://www.businessdictionary.com/definition/percentile.html (14 November 2012).

Business Dictionary. 2012b. *Quintiles*. (Online). Available: http://www.businessdictionary.com/definition/quintile.html (14 November 2012).

Cameron, B. 2009. *What you need to consider when purchasing a pension.* (Online). Available: http://www.persfin.co.za/index.php?fSectionId=595&fArticleId=4888612 (30 September 2010).

Charupat, N. & Milevsky, M.A. 2002. Optimal asset allocation in life annuities: A note. *Insurance: Mathematics and Economics*, 30(2): 199-209.

Davidoff, T., Brown, J.R. & Diamond, P.A. 2005. Annuities and Individual Welfare. *American Economic Review*, 95(5): 1573-1590.

Dus, I., Maurer R. & Mitchell O.S. 2005. Betting on death and capital markets in retirement: a shortfall risk analysis of life annuities versus phased withdrawal plans. *Financial Services Review*, 14: 169-196.

Firer, C. & McLeod, H. 1999. Equities, bonds, cash and inflation: Historical performance in South Africa 1925 to 1998. *Investment Analyst Journal*, 50(1): 7-28.

FTSE/JSE. 2008. *Africa Index Series, A comprehensive guide.* (Online) Available: http://www.jse.co.za/Libraries/FTSE-JSE_-_Education_-_Comprehensive_Guide/FTSEGuide.sflb.ashx (24 August 2012).

Gardner, J. & Wadsworth, M. 2004. *Who Would Purchase an Annuity? An Empirical Investigation.* Watson Wyatt What If? Technical Paper, March.

Gerrard, R., Haberman, S. & Vigna, E. 2004. Optimal investment choices post-retirement in a defined contribution pension scheme. *Insurance: Mathematics and Economics*, 35(2): 321-342.

Goemans, M. & Ncube, M. 2008. *Optimal Annuity Strategies after Retirement.* Presented at the South African Actuarial Convention, October.

Harmse, C. 2006. *The relationship between South Africa's macroeconomic policies and the performance of the various asset classes.* South African Reserve Bank Conference. (Online). Available: http://www.resbank.co.za/Lists/News%20and%20Publications/Attachments/56/Harmse.pdf (15 October 2012).

Horneff, W.J., Maurer, R., Mitchell, O.S. & Dus, I. 2008. Following the rules: Integrating asset allocation and annuitization in retirement portfolios. *Insurance: Mathematics and Economics*, 42: 396-408.

Horneff, W.J., Maurer, R.H. & Stamos, M.Z. 2008a. Life-cycle asset allocation with annuity markets. *The Journal of Economic Dynamics & Control*, 32: 3590-3612.

Horneff, W.J., Maurer, R.H. & Stamos, M.Z. 2008b. Optimal Gradual Annuitization: Quantifying the Costs of Switching to Annuities. *The Journal of Risk and Insurance*, 75(4): 1019-1038.

Johannesburg Stock Exchange (JSE). 2000. *BEASSA Total Return Indices.* (Online). Available: http://www.jse.co.za/Libraries/BESA_related_documents/BEASSA_total_return_indices_2000.sflb.ashx (24 August 2012).

Johannesburg Stock Exchange (JSE). 2010. *ASSA Fixed Income Indices*. (Online). Available: http://www.jse.co.za/Libraries/BESA_Indices_overview/Tribook.sflb.ashx (24 August 2012).

Kahneman, D. & Tversky, A. 1979. Prospect theory: an analysis of decision under risk. *Econometrica*, 47: 263-291.

Kapur, S. & Orszag, J.M. 1999. *A portfolio approach to investment and annuitization during retirement*. London, University of London, Mimeo, Birbeck College.

Kingston, G. & Thorp, S. 2005. Annuitization and asset allocation with HARA utility. *Journal of Pension Economics and Finance*, 4(3): 225-248.

Koijen, R.S., Nijman, T. & Werker, B.J.M. 2006. *Dynamic asset allocation with annuity risk*. In: Working Paper, Tilburg University, Center for Economic Research.

Life Offices Association of South Africa (LOA). 2008. *Code on Living Annuities*. Circular No: 82/2008. (Online). Available: http://www.docstoc.com/docs/18565164/LOA-CIRCULAR-22nd-FLOOR-ABSA-CENTRE-2-RIEBEEK-STREET-P-O-BOX-5023 (14 November 2012).

Lodhia, M. & Swanepoel, J. 2012. *Living versus guaranteed annuities: In search of a sustainable retirement income*. Presented at the South African Actuarial Convention, October.

Marx, G.L. & Hanekom, K. 2009. *The Manual on South African Retirement Funds and Employee Benefits*. Durban: LexisNexis.

Merton, R.C. 1969. Lifetime portfolio selection under uncertainty. The continuous-time case. *Review of Economics and Statistics*, 51: 247-257.

Merton, R.C. 1971. Optimum consumption and portfolio rules in a continuous time model. *Journal of Economic Theory*, 3(4): 373-413.

Merton, R.C. 1983. On comsumption indexed public pension plans. In: Bodie, Z., Shoven, J. (Eds.). *Financial Aspects of the US Pension System*. Chicago: University of Chicago Press.

Milevsky, M.A. 1998. Optimal Asset Allocation Towards the End of the Life Cycle: To Annuitize or Not to Annuitize? *The Journal of Risk and Insurance*, 65(3): 401-426.

Milevsky, M.A., Moore, K.S. & Young, V. 2006. Asset allocation and annuity-purchases strategies to minimize the probability of financial ruin. *Mathematical Finance*, 16(4): 647-671.

Milevsky, M. & Young V.R. 2002. *Optimal Asset Allocation and The Real Option to Delay Annuitization: It's Not Now-or-Never* (Online). Available: http://www.ifid.ca/pdf_workingpapers/WP2002B.pdf (11 October 2010).

Milevsky, M. & Young V.R. 2003. *Annuitization and Asset Allocation* (Online). Available: http://www.ifid.ca/pdf_workingpapers/WP2003OCT15.pdf (11 October 2010).

Milevsky, M. & Young V.R. 2007. The timing of annuitization: Investment dominance and

mortality risk. *Insurance: Mathematics and Economics*, 40: 135-144.

Mitchell, O.S., Poterba, J.M., Warshawsky, M.J. & Brown, J.R. 1999. New Evidence on the Money's worth of Individual Annuities. *The American Economic Review*, 89(5): 1299-1318.

National Treasury. 2007. *Social Security and Retirement Reform Second Discussion Paper*. (Online). Available: http://www.treasury.gov.za/documents/national%20budget/2007/Social%20security%20and%20retirement%20reform%20paper.pdf (29 June 2011).

National Treasury. 2012. Technical Discussion Paper B for public comment. *Enabling a better income in retirement*. (Online). Available: http://www.treasury.gov.za/comm_media/press/2012/Enabling%20a%20better%20income%20in%20retirement.pdf (23 November 2012).

Nienaber, P.M. & Reinecke, M.F.B. 2009. *Life Insurance in South Africa*. Durban: LexisNexis.

Personal Finance (Persfin). 2010. *Choosing the right pension for your retirement - Part I*. (Online). Available: http://www.persfin.co.za/index.php?fSectionId=595&fArticleId=5481046 (30 September 2010).

Pillay, D. 2009. *Latest amendments to living annuities*. (Online). Available: http://www.sanlam.co.za/wps/wcm/connect/840bd9004edaee06b683b6111d919974/LegalMatters-June2009.pdf?MOD=AJPERES (28 June 2011).

Reno, V., Graetz, K., Apfel, K., Lavery, J. & Hill, C. 2005. *Uncharted Waters: Paying Benefits from Individual Accounts in Federal Retirement Policy*. Washington D.C., Study Panel Final Report, National Academy of Social Insurance, April.

Republic of South Africa. 1956. *Pension Funds Act 24 of 1956*. Pretoria: Government Printer.

Republic of South Africa. 1962. *Income Tax Act 52 of 1962*. Pretoria: Government Printer.

Republic of South Africa. 1998. *Long-Term Insurance Act 52 of 1998*. Pretoria: Government Printer.

Republic of South Africa. 2008. *Revenue Laws Amendment Act 60 of 2008*. Pretoria: Government Printer.

Richard, S.F. 1975. Optimal consumption, portfolio and life insurance rules for an uncertain lived individual in a continuous time model. *Journal of Financial Economics*, 2: 187-203.

Rusconi, R. 2006a. *The Demand for Annuities*. Presented to the OECD/IOPS Global Forum on Private Pensions, Istanbul, November.

Rusconi, R. 2006b. *Non-Profit Annuities: Thoughts on South Africa*. Prepared for presentation at the Actuarial Society of South Africa, February.

Samie, F. 2011. *How scrapping compulsory annuitisation will affect schemes.* (Online). Available: http://www.professionalpensions.com/professional-pensions/news/2125227/annuitisation-change (20 November 2012).

Schmeiser, H. & Post, T. 2005. Life Annuity Insurance versus Self-Annuitization: An Analysis from the Perspective of the Family. *Risk Management and Insurance Review*, 8(2): 239-255.

South African Revenue Services (SARS). 2009. *Government Notice 290 of 11 March 2009.* (Online). Available: http://www.google.co.za/search?hl=en&q=Government+Notice+No.+290+of+11+March+2009&meta=&aq=f&aqi=&aql=&oq=&gs_rfai= (30 September 2010).

Statistics South Africa (StatsSA). 2009. *Consumer Price Index, key changes in 2009.* (Online). Available: http://www.statssa.gov.za/cpi/documents/CPI%20booklet%20-%20final%2016%20Oct%2008.pdf (24 August 2012).

TaxTips.ca. 2011. *RRSPs and RRIFs.* (Online). Available: http://www.taxtips.ca/RRSPs.htm (28 June 2011).

The Brandes Institute. 2012. *Boomers Behaving Badly: A Better Solution to the "Money Death" Problem. (Online).* Available: https://www.brandes.com/Institute/Documents/Boomers%20White%20Paper%20.pdf (10 January 2012).

Thomson, R. 2001. A re-evaluation of the South African Bond Exchange-Actuaries Indices. *Investment Analysts Journal*, 53(2): 19-28.

Yaari, M., 1965. Uncertain lifetime, life insurance and the theory of the consumer. *Review of Economic Studies*, 32: 137-150.

Appendix A

Present values of annuity strategies

Table A.1A: Present values of living annuity strategies for asset allocation A

Asset allocation	A								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	Liv-A-a-55	Liv-A-a-60	Liv-A-a-65	Liv-A-b-55	Liv-A-b-60	Liv-A-b-65	Liv-A-c-55	Liv-A-c-60	Liv-A-c-65
1960-01	R 1 019 739.52	R 1 012 062.96	R 1 145 908.41	R 1 132 478.40	R 1 152 923.82	R 1 211 219.61	R 1 187 642.22	R 1 177 921.65	R 1 217 229.85
1961-01	R 1 016 534.79	R 1 079 926.47	R 1 110 780.70	R 1 124 421.82	R 1 167 944.48	R 1 202 239.95	R 1 177 534.49	R 1 201 022.55	R 1 191 917.32
1962-01	R 1 070 116.90	R 1 105 537.05	R 1 083 338.44	R 1 109 415.13	R 1 152 196.89	R 1 175 453.63	R 1 188 658.76	R 1 207 487.44	R 1 171 576.15
1963-01	R 874 882.98	R 900 973.81	R 889 328.26	R 968 597.33	R 999 421.45	R 1 020 434.24	R 1 143 419.12	R 1 141 425.89	R 1 098 544.74
1964-01	R 779 268.32	R 806 904.50	R 828 229.44	R 885 561.46	R 916 136.50	R 944 433.51	R 1 122 946.26	R 1 115 961.82	R 1 080 232.89
1965-01	R 785 292.35	R 857 350.30	R 867 721.73	R 877 953.21	R 918 986.50	R 951 541.50	R 1 104 583.57	R 1 111 468.33	R 1 079 678.68
1966-01	R 850 754.60	R 854 661.62	R 932 873.88	R 890 729.68	R 914 828.38	R 974 154.81	R 1 114 761.32	R 1 110 295.06	R 1 105 551.50
1967-01	R 830 413.66	R 836 489.19	R 897 075.81	R 882 849.71	R 906 754.51	R 953 127.52	R 1 104 440.02	R 1 100 709.83	R 1 087 407.79
1968-01	R 768 858.35	R 768 530.96	R 795 966.74	R 806 224.88	R 827 907.14	R 859 659.78	R 1 085 213.29	R 1 078 447.55	R 1 047 511.94
1969-01	R 688 495.69	R 695 610.31	R 737 731.81	R 715 269.07	R 735 244.87	R 773 332.92	R 1 062 590.65	R 1 056 101.11	R 1 026 673.07
1970-01	R 687 616.21	R 680 779.47	R 711 392.72	R 708 556.81	R 724 448.10	R 753 133.54	R 1 021 883.27	R 1 014 646.80	R 984 952.18
1971-01	R 820 218.30	R 816 180.52	R 806 769.78	R 821 574.22	R 824 085.40	R 835 645.20	R 1 059 463.83	R 1 055 603.06	R 1 018 376.60
1972-01	R 885 375.16	R 884 068.37	R 851 208.74	R 878 865.20	R 877 024.79	R 861 447.97	R 1 073 929.31	R 1 073 163.96	R 1 033 176.18
1973-01	R 801 110.99	R 738 043.77	R 762 185.47	R 781 267.87	R 741 471.24	R 764 758.95	R 1 026 321.87	R 1 013 022.31	R 984 693.58
1974-01	R 771 599.30	R 741 548.54	R 723 384.43	R 762 248.12	R 741 939.89	R 741 419.77	R 1 034 484.07	R 1 024 181.30	R 985 397.04
1975-01	R 961 162.49	R 872 593.42	R 836 878.92	R 961 324.80	R 867 605.32	R 838 352.40	R 1 045 998.40	R 1 033 002.58	R 1 000 373.35
1976-01	R 1 068 424.34	R 1 042 245.47	R 975 426.83	R 1 081 481.32	R 1 045 351.58	R 970 209.98	R 1 100 837.33	R 1 105 046.06	R 1 077 709.71
1977-01	R 1 260 743.71	R 1 124 489.02	R 1 066 216.57	R 1 316 661.17	R 1 129 889.79	R 1 058 419.10	R 1 179 388.82	R 1 130 706.90	R 1 103 124.00
1978-01	R 1 178 968.88	R 1 179 165.11	R 1 034 005.73	R 1 207 844.86	R 1 212 645.90	R 1 028 082.45	R 1 139 148.03	R 1 151 101.57	R 1 091 890.27
1979-01	R 1 190 387.11	R 1 053 590.84	R 967 511.62	R 1 230 443.34	R 1 056 527.45	R 961 740.24	R 1 155 475.98	R 1 134 403.21	R 1 098 530.59
1980-01	R 1 091 666.06	R 964 299.44	R 896 377.10	R 1 100 000.70	R 950 814.60	R 875 551.96	R 1 073 836.62	R 1 058 817.28	R 1 030 849.53
1981-01	R 1 273 150.33	R 1 044 393.47	R 950 717.76	R 1 347 548.78	R 1 053 401.20	R 947 182.41	R 1 104 466.20	R 1 037 305.33	R 1 004 215.53
1982-01	R 1 465 654.38	R 1 330 181.08	R 1 189 134.26	R 1 581 697.23	R 1 405 648.15	R 1 211 408.00	R 1 350 026.25	R 1 226 374.35	R 1 138 373.47
1983-01	R 1 379 917.73	R 1 218 602.74	R 1 018 533.25	R 1 414 343.50	R 1 213 450.35	R 998 988.67	R 1 162 442.98	R 1 134 199.26	R 1 077 842.27
1984-01	R 1 679 162.49	R 1 430 039.76	R 1 203 619.84	R 1 862 134.24	R 1 518 150.64	R 1 222 173.28	R 1 498 034.44	R 1 288 657.41	R 1 144 409.00
1985-01	R 2 058 376.68	R 1 619 411.07	R 1 306 673.38	R 2 408 776.78	R 1 765 974.61	R 1 337 854.91	R 2 027 967.76	R 1 576 540.94	R 1 289 781.79
1986-01	R 2 190 131.38	R 1 798 813.90	R 1 510 941.82	R 2 519 589.14	R 1 970 369.60	R 1 577 774.73	R 2 146 473.86	R 1 733 560.09	R 1 454 104.88
1987-01	R 1 863 300.66	R 1 677 207.48	R 1 373 246.65	R 1 998 514.75	R 1 763 925.41	R 1 385 712.33	R 1 710 312.45	R 1 504 143.95	R 1 260 617.71
1988-01	R 1 985 442.38	R 1 964 120.08	R 1 537 599.18	R 2 188 097.61	R 2 206 368.25	R 1 615 032.54	R 2 002 428.32	R 1 949 108.77	R 1 501 612.12
1989-01	R 2 143 323.33	R 2 154 358.73	R 1 642 336.86	R 2 332 423.56	R 2 384 671.45	R 1 703 866.47	R 2 152 558.31	R 2 130 199.64	R 1 604 928.19

Table A.1B: Present values of living annuity strategies for asset allocation B

Asset allocation	B								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	Liv-B-a-55	Liv-B-a-60	Liv-B-a-65	Liv-B-b-55	Liv-B-b-60	Liv-B-b-65	Liv-B-c-55	Liv-B-c-60	Liv-B-c-65
1960-01	R 1 340 330.35	R 1 210 954.93	R 1 384 343.26	R 1 329 645.55	R 1 311 207.21	R 1 382 736.88	R 1 319 600.46	R 1 271 886.00	R 1 361 324.24
1961-01	R 1 420 640.67	R 1 390 928.96	R 1 404 592.12	R 1 406 800.65	R 1 403 662.28	R 1 434 466.97	R 1 403 353.94	R 1 380 919.67	R 1 415 912.52
1962-01	R 1 517 944.45	R 1 476 944.84	R 1 338 541.73	R 1 457 540.17	R 1 424 016.09	R 1 378 755.13	R 1 453 314.95	R 1 421 605.31	R 1 355 645.35
1963-01	R 1 235 910.59	R 1 222 052.74	R 1 083 423.88	R 1 200 624.53	R 1 217 658.42	R 1 191 467.17	R 1 247 647.34	R 1 267 537.46	R 1 184 370.17
1964-01	R 1 071 597.51	R 1 073 732.30	R 997 283.62	R 1 071 786.86	R 1 088 089.98	R 1 090 241.34	R 1 193 828.42	R 1 203 358.08	R 1 147 265.37
1965-01	R 1 087 139.63	R 1 145 959.92	R 1 037 210.99	R 1 059 756.15	R 1 090 184.02	R 1 085 085.80	R 1 172 020.40	R 1 203 072.59	R 1 155 495.66
1966-01	R 1 197 063.71	R 1 119 339.99	R 1 148 644.36	R 1 124 765.57	R 1 081 957.19	R 1 121 796.21	R 1 201 340.79	R 1 190 348.95	R 1 208 786.78
1967-01	R 1 088 039.61	R 1 060 029.47	R 1 090 422.59	R 1 062 472.07	R 1 047 347.89	R 1 079 070.75	R 1 169 023.29	R 1 165 922.94	R 1 176 893.74
1968-01	R 1 018 921.60	R 988 273.91	R 960 479.76	R 976 179.85	R 957 670.61	R 959 543.14	R 1 136 329.37	R 1 136 462.99	R 1 113 895.82
1969-01	R 874 489.06	R 858 094.52	R 843 856.87	R 789 561.22	R 794 813.37	R 812 232.94	R 1 095 046.90	R 1 094 400.10	R 1 066 466.25
1970-01	R 894 688.61	R 854 379.70	R 860 235.73	R 861 588.51	R 832 290.59	R 832 417.32	R 1 030 183.59	R 1 023 216.57	R 1 009 283.46
1971-01	R 1 186 627.10	R 1 138 347.33	R 1 056 192.82	R 1 176 526.71	R 1 120 326.60	R 1 041 738.80	R 1 166 743.92	R 1 154 483.49	R 1 104 216.80
1972-01	R 1 255 547.80	R 1 273 881.24	R 1 148 741.44	R 1 252 345.07	R 1 269 511.52	R 1 130 028.57	R 1 215 508.47	R 1 221 594.63	R 1 160 044.00
1973-01	R 1 071 011.08	R 948 319.17	R 984 851.85	R 1 049 086.60	R 920 430.55	R 933 148.06	R 1 073 553.05	R 1 050 158.37	R 1 043 980.48
1974-01	R 1 071 958.81	R 1 008 169.51	R 923 085.13	R 1 041 215.23	R 971 425.04	R 897 465.01	R 1 120 623.14	R 1 111 797.81	R 1 065 697.05
1975-01	R 1 316 025.69	R 1 127 046.43	R 1 063 484.15	R 1 355 600.26	R 1 117 259.49	R 1 043 883.31	R 1 181 578.72	R 1 104 908.33	R 1 076 328.64
1976-01	R 1 539 767.37	R 1 463 282.81	R 1 370 013.67	R 1 600 470.97	R 1 513 380.54	R 1 381 656.82	R 1 483 065.50	R 1 398 615.41	R 1 317 560.16
1977-01	R 1 835 364.34	R 1 647 407.74	R 1 491 175.19	R 1 968 189.98	R 1 703 564.20	R 1 493 864.95	R 1 875 297.15	R 1 661 466.23	R 1 494 928.78
1978-01	R 1 653 754.14	R 1 720 748.57	R 1 463 891.17	R 1 713 619.93	R 1 862 693.89	R 1 486 127.41	R 1 664 129.86	R 1 714 740.18	R 1 462 479.08
1979-01	R 1 674 456.77	R 1 500 333.66	R 1 323 833.96	R 1 815 649.44	R 1 566 549.14	R 1 334 699.59	R 1 595 540.12	R 1 446 809.25	R 1 307 222.26
1980-01	R 1 335 614.95	R 1 188 871.13	R 1 104 466.36	R 1 406 275.35	R 1 210 510.64	R 1 104 225.71	R 1 184 037.19	R 1 135 050.53	R 1 108 079.94
1981-01	R 1 414 287.72	R 1 151 576.78	R 1 082 529.90	R 1 527 392.54	R 1 164 897.37	R 1 087 398.87	R 1 305 053.62	R 1 120 515.45	R 1 062 191.80
1982-01	R 1 583 844.34	R 1 506 148.98	R 1 385 592.06	R 1 698 795.72	R 1 614 617.31	R 1 442 011.13	R 1 549 904.70	R 1 453 882.87	R 1 333 659.01
1983-01	R 1 497 688.29	R 1 359 663.98	R 1 176 446.98	R 1 572 448.15	R 1 389 327.79	R 1 166 659.31	R 1 311 259.95	R 1 231 747.84	R 1 155 404.50
1984-01	R 1 749 520.42	R 1 538 611.88	R 1 312 097.37	R 1 950 199.48	R 1 654 931.96	R 1 341 487.43	R 1 662 758.08	R 1 455 341.04	R 1 266 122.57
1985-01	R 2 208 872.07	R 1 654 719.09	R 1 384 651.23	R 2 626 299.23	R 1 778 137.79	R 1 405 514.64	R 2 277 897.58	R 1 657 519.27	R 1 383 973.47
1986-01	R 2 282 852.48	R 1 742 151.47	R 1 531 056.00	R 2 671 994.11	R 1 887 940.77	R 1 595 350.22	R 2 252 487.19	R 1 697 898.70	R 1 485 183.24
1987-01	R 1 891 257.89	R 1 565 130.40	R 1 324 868.69	R 2 022 794.80	R 1 613 902.37	R 1 322 194.93	R 1 673 978.82	R 1 392 593.91	R 1 234 050.13
1988-01	R 2 016 907.36	R 2 004 457.63	R 1 552 833.05	R 2 245 207.66	R 2 304 539.24	R 1 643 640.73	R 2 073 468.32	R 2 046 308.56	R 1 547 024.81
1989-01	R 2 222 750.01	R 2 239 080.43	R 1 576 995.66	R 2 448 182.98	R 2 511 552.90	R 1 619 777.91	R 2 238 073.87	R 2 212 908.95	R 1 556 070.07

Table A.1C: Present values of living annuity strategies for asset allocation C

Asset allocation	C								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	Liv-C-a-55	Liv-C-a-60	Liv-C-a-65	Liv-C-b-55	Liv-C-b-60	Liv-C-b-65	Liv-C-c-55	Liv-C-c-60	Liv-C-c-65
1960-01	R 1 767 901.04	R 1 437 630.48	R 1 664 626.87	R 1 625 773.45	R 1 473 640.88	R 1 585 273.18	R 1 692 008.38	R 1 425 251.67	R 1 612 348.37
1961-01	R 2 001 751.19	R 1 779 393.72	R 1 767 826.32	R 1 976 886.34	R 1 757 068.59	R 1 769 207.94	R 2 010 622.38	R 1 759 493.03	R 1 767 830.72
1962-01	R 2 166 875.01	R 1 962 830.64	R 1 639 030.14	R 2 177 167.16	R 1 933 169.53	R 1 644 731.52	R 2 195 173.48	R 1 950 893.85	R 1 629 911.56
1963-01	R 1 756 580.44	R 1 652 059.95	R 1 304 055.39	R 1 676 908.84	R 1 566 073.93	R 1 355 334.87	R 1 684 074.54	R 1 576 137.46	R 1 326 826.61
1964-01	R 1 481 080.16	R 1 426 639.30	R 1 184 979.05	R 1 400 714.29	R 1 340 178.52	R 1 238 624.99	R 1 394 686.34	R 1 361 460.41	R 1 251 469.74
1965-01	R 1 521 511.19	R 1 526 619.48	R 1 221 582.29	R 1 410 106.80	R 1 361 755.43	R 1 223 917.91	R 1 390 487.13	R 1 365 841.31	R 1 257 631.78
1966-01	R 1 708 651.05	R 1 460 984.66	R 1 392 528.74	R 1 605 429.54	R 1 368 101.18	R 1 303 441.75	R 1 500 737.38	R 1 335 992.14	R 1 349 156.34
1967-01	R 1 421 791.49	R 1 339 241.84	R 1 308 077.77	R 1 336 409.24	R 1 257 343.36	R 1 228 433.09	R 1 323 737.48	R 1 264 396.09	R 1 288 082.49
1968-01	R 1 351 834.31	R 1 274 232.12	R 1 146 297.85	R 1 245 050.84	R 1 157 777.99	R 1 079 895.22	R 1 227 596.16	R 1 215 845.17	R 1 194 156.60
1969-01	R 1 123 035.42	R 1 072 401.08	R 959 704.15	R 880 819.38	R 871 674.67	R 853 719.04	R 1 132 964.45	R 1 139 698.84	R 1 105 882.01
1970-01	R 1 161 916.78	R 1 071 895.96	R 1 037 998.53	R 1 083 731.86	R 995 014.63	R 941 513.65	R 1 070 227.14	R 1 045 094.92	R 1 045 937.07
1971-01	R 1 722 317.63	R 1 595 601.58	R 1 382 953.68	R 1 748 385.15	R 1 597 059.03	R 1 355 355.54	R 1 644 293.02	R 1 509 264.13	R 1 321 421.50
1972-01	R 1 758 049.63	R 1 844 184.86	R 1 553 960.71	R 1 775 431.12	R 1 912 416.21	R 1 546 652.69	R 1 702 948.60	R 1 737 564.01	R 1 469 144.03
1973-01	R 1 417 385.72	R 1 214 666.58	R 1 286 230.75	R 1 394 164.11	R 1 153 397.74	R 1 193 621.73	R 1 220 409.06	R 1 126 657.22	R 1 134 804.81
1974-01	R 1 469 369.09	R 1 367 211.23	R 1 172 741.35	R 1 409 472.41	R 1 288 234.10	R 1 089 488.59	R 1 279 301.41	R 1 238 047.33	R 1 156 752.96
1975-01	R 1 768 052.73	R 1 436 097.71	R 1 349 534.32	R 1 849 234.58	R 1 410 244.80	R 1 314 162.51	R 1 656 095.24	R 1 361 080.51	R 1 259 739.90
1976-01	R 2 169 901.12	R 2 020 511.32	R 1 924 060.84	R 2 288 526.69	R 2 125 091.00	R 2 002 508.02	R 2 200 216.60	R 2 017 955.58	R 1 888 139.39
1977-01	R 2 583 838.20	R 2 362 635.75	R 2 056 723.92	R 2 780 349.51	R 2 506 042.60	R 2 080 669.93	R 2 771 470.83	R 2 492 753.18	R 2 088 851.52
1978-01	R 2 234 775.16	R 2 439 999.92	R 2 039 739.70	R 2 294 067.91	R 2 726 364.48	R 2 123 112.00	R 2 301 770.67	R 2 624 167.66	R 2 093 612.20
1979-01	R 2 251 549.13	R 2 064 318.05	R 1 761 539.69	R 2 466 300.97	R 2 206 298.44	R 1 790 592.27	R 2 341 812.23	R 2 109 770.62	R 1 771 868.40
1980-01	R 1 578 827.06	R 1 425 975.28	R 1 336 320.59	R 1 682 563.69	R 1 470 897.55	R 1 365 738.46	R 1 501 697.43	R 1 369 273.19	R 1 275 159.58
1981-01	R 1 528 616.97	R 1 244 828.97	R 1 216 842.40	R 1 655 608.07	R 1 245 361.93	R 1 235 619.22	R 1 494 548.42	R 1 235 647.70	R 1 193 032.23
1982-01	R 1 665 564.34	R 1 662 882.96	R 1 587 792.81	R 1 744 419.18	R 1 783 493.26	R 1 684 769.93	R 1 674 673.99	R 1 657 670.91	R 1 564 261.30
1983-01	R 1 576 409.05	R 1 475 375.76	R 1 333 671.93	R 1 657 162.08	R 1 524 257.35	R 1 335 694.91	R 1 470 862.12	R 1 372 130.06	R 1 266 841.33
1984-01	R 1 766 616.14	R 1 609 067.75	R 1 399 186.51	R 1 949 939.04	R 1 729 475.36	R 1 428 596.87	R 1 741 290.15	R 1 570 559.13	R 1 375 500.16
1985-01	R 2 281 981.09	R 1 645 738.93	R 1 435 002.10	R 2 727 291.26	R 1 719 052.06	R 1 430 176.15	R 2 420 340.65	R 1 662 648.56	R 1 437 316.57
1986-01	R 2 291 554.56	R 1 642 767.91	R 1 515 125.51	R 2 701 295.93	R 1 746 820.77	R 1 567 618.59	R 2 243 547.50	R 1 607 985.95	R 1 476 191.80
1987-01	R 1 849 582.14	R 1 420 738.28	R 1 247 367.45	R 1 942 395.57	R 1 431 400.91	R 1 230 426.23	R 1 540 174.54	R 1 274 189.91	R 1 198 590.67
1988-01	R 1 965 765.36	R 1 979 945.27	R 1 530 539.34	R 2 180 147.29	R 2 305 636.85	R 1 618 962.85	R 2 033 385.79	R 2 052 839.11	R 1 541 252.52
1989-01	R 2 202 792.64	R 2 245 821.04	R 1 480 258.17	R 2 422 862.00	R 2 520 023.46	R 1 499 370.44	R 2 194 700.68	R 2 183 258.46	R 1 471 586.21

Table A.2: Present values of life annuity strategies

Asset allocation	Level			5% increase		
Drawdown strategy						
Retirement date/age	55	60	65	55	60	65
	Lif-0%-55	Lif-0%-60	Lif-0%-65	Lif-5%-55	Lif-5%-60	Lif-5%-65
1960-01	R 1 096 417.36	R 1 116 606.03	R 1 063 468.15	R 981 873.13	R 1 019 294.90	R 970 364.04
1961-01	R 1 051 927.30	R 1 075 186.43	R 1 032 022.17	R 935 796.26	R 976 179.70	R 939 080.71
1962-01	R 1 036 176.63	R 1 057 622.15	R 1 017 234.87	R 925 944.28	R 963 111.63	R 927 767.59
1963-01	R 912 189.86	R 947 844.11	R 931 238.32	R 778 879.59	R 833 772.36	R 829 153.39
1964-01	R 853 596.80	R 889 513.20	R 880 402.16	R 721 668.75	R 775 741.04	R 779 325.22
1965-01	R 866 236.35	R 902 288.45	R 896 845.80	R 730 627.36	R 784 472.69	R 792 230.84
1966-01	R 875 864.42	R 904 073.89	R 893 603.41	R 753 944.97	R 797 054.77	R 796 962.60
1967-01	R 893 707.65	R 920 344.28	R 909 430.08	R 772 697.13	R 813 536.57	R 811 916.81
1968-01	R 820 360.14	R 846 890.82	R 840 492.56	R 702 714.24	R 742 655.98	R 745 545.58
1969-01	R 768 358.62	R 794 475.74	R 791 452.04	R 653 024.81	R 691 798.37	R 698 184.52
1970-01	R 734 122.84	R 759 905.21	R 759 955.93	R 619 654.98	R 657 489.94	R 667 280.80
1971-01	R 766 782.84	R 784 657.85	R 777 678.99	R 665 674.36	R 692 657.78	R 692 719.88
1972-01	R 779 033.28	R 792 531.88	R 782 313.20	R 686 066.65	R 706 709.34	R 701 778.89
1973-01	R 721 083.26	R 736 124.07	R 730 104.11	R 627 341.65	R 649 785.87	R 649 931.52
1974-01	R 700 453.35	R 713 776.44	R 707 775.27	R 610 103.18	R 630 071.65	R 629 788.24
1975-01	R 771 377.95	R 777 109.18	R 763 078.17	R 691 803.83	R 700 224.56	R 689 006.64
1976-01	R 802 070.19	R 802 965.06	R 784 487.19	R 729 664.92	R 730 276.13	R 712 619.07
1977-01	R 838 128.00	R 832 118.09	R 806 640.34	R 779 066.61	R 768 315.31	R 740 034.18
1978-01	R 808 249.84	R 802 260.77	R 777 588.12	R 748 143.91	R 737 365.82	R 709 858.43
1979-01	R 716 910.34	R 717 531.06	R 701 033.57	R 643 875.90	R 643 662.28	R 627 593.56
1980-01	R 720 115.70	R 719 111.01	R 700 218.76	R 648 453.24	R 645 658.16	R 626 061.43
1981-01	R 902 253.02	R 879 061.42	R 832 865.53	R 874 782.73	R 834 452.76	R 774 459.28
1982-01	R 983 590.24	R 948 582.56	R 886 858.50	R 984 126.42	R 922 835.04	R 838 285.01
1983-01	R 815 703.23	R 799 103.88	R 758 096.18	R 772 102.18	R 744 159.09	R 692 447.24
1984-01	R 985 621.16	R 943 399.42	R 869 906.11	R 1 006 022.43	R 931 604.73	R 828 598.08
1985-01	R 1 136 432.52	R 1 070 737.31	R 968 640.95	R 1 221 906.17	R 1 101 662.05	R 951 242.65
1986-01	R 1 246 742.01	R 1 165 610.98	R 1 044 633.92	R 1 369 616.32	R 1 219 657.67	R 1 038 809.07
1987-01	R 1 184 644.27	R 1 112 775.14	R 1 000 666.55	R 1 270 879.16	R 1 142 321.58	R 979 726.15
1988-01	R 1 296 597.88	R 1 211 389.87	R 1 077 322.33	R 1 423 415.19	R 1 268 910.40	R 1 070 598.96
1989-01	R 1 361 918.81	R 1 269 094.12	R 1 117 128.61	R 1 518 096.64	R 1 348 685.22	R 1 121 298.50

Table A.3A: Present values of composite annuity strategies – asset allocation A with life annuity (0%)

	Composite with life annuity (0%)								
Asset allocation	A								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-A-a-55-0%]	C[Liv-A-a-60-0%]	C[Liv-A-a-65-0%]	C[Liv-A-b-55-0%]	C[Liv-A-b-60-0%]	C[Liv-A-b-65-0%]	C[Liv-A-c-55-0%]	C[Liv-A-c-60-0%]	C[Liv-A-c-65-0%]
1960-01	R 1 058 078.44	R 1 064 334.50	R 1 104 688.29	R 1 114 447.88	R 1 134 764.93	R 1 137 343.89	R 1 142 029.79	R 1 147 263.85	R 1 140 349.00
1961-01	R 1 034 231.04	R 1 077 556.45	R 1 071 401.44	R 1 088 174.56	R 1 121 565.45	R 1 117 131.06	R 1 114 730.90	R 1 138 104.49	R 1 111 969.75
1962-01	R 1 053 146.76	R 1 081 579.60	R 1 050 286.66	R 1 072 795.87	R 1 104 909.51	R 1 096 344.25	R 1 112 417.69	R 1 132 554.79	R 1 094 405.51
1963-01	R 893 536.42	R 924 408.97	R 910 283.29	R 940 393.59	R 973 632.78	R 975 836.28	R 1 027 804.49	R 1 044 635.00	R 1 014 891.53
1964-01	R 816 432.56	R 848 208.85	R 854 315.80	R 869 579.13	R 902 824.85	R 912 417.84	R 988 271.53	R 1 002 737.51	R 980 317.52
1965-01	R 825 764.35	R 879 819.37	R 882 283.76	R 872 094.78	R 910 637.47	R 924 193.65	R 985 409.97	R 1 006 878.38	R 988 262.24
1966-01	R 863 309.51	R 879 367.76	R 913 238.65	R 883 297.05	R 909 451.14	R 933 879.11	R 995 312.87	R 1 007 184.48	R 999 577.46
1967-01	R 862 060.65	R 878 416.74	R 903 252.94	R 888 278.67	R 913 549.39	R 931 278.80	R 999 073.83	R 1 010 527.06	R 998 418.94
1968-01	R 794 609.24	R 807 710.89	R 818 229.65	R 813 292.51	R 837 398.98	R 850 076.17	R 952 786.72	R 962 669.19	R 944 002.25
1969-01	R 728 427.15	R 745 043.03	R 764 591.93	R 741 813.84	R 764 860.31	R 782 392.48	R 915 474.64	R 925 288.42	R 909 062.55
1970-01	R 710 869.52	R 720 342.35	R 735 674.32	R 721 339.82	R 742 176.66	R 756 544.73	R 878 003.06	R 887 276.01	R 872 454.05
1971-01	R 793 500.57	R 800 419.18	R 792 224.39	R 794 178.53	R 804 371.62	R 806 662.10	R 913 123.33	R 920 130.45	R 898 027.80
1972-01	R 832 204.22	R 838 300.13	R 816 760.97	R 828 949.24	R 834 778.33	R 821 880.59	R 926 481.29	R 932 847.92	R 907 744.69
1973-01	R 761 097.13	R 737 083.93	R 746 144.79	R 751 175.56	R 738 797.66	R 747 431.54	R 873 702.56	R 874 573.20	R 857 398.85
1974-01	R 736 026.33	R 727 662.49	R 715 579.86	R 731 350.74	R 727 858.16	R 724 597.53	R 867 468.72	R 868 978.87	R 846 586.16
1975-01	R 866 270.22	R 824 851.30	R 799 978.54	R 866 351.38	R 822 357.25	R 800 715.28	R 908 688.18	R 905 055.88	R 881 725.75
1976-01	R 935 247.26	R 922 605.27	R 879 957.02	R 941 775.75	R 924 158.32	R 877 348.59	R 951 453.75	R 954 005.56	R 931 098.45
1977-01	R 1 049 435.86	R 978 303.56	R 936 428.46	R 1 077 394.59	R 981 003.94	R 932 529.72	R 1 008 758.41	R 981 412.50	R 954 882.17
1978-01	R 993 609.36	R 990 712.94	R 905 796.92	R 1 008 047.35	R 1 007 453.33	R 902 835.28	R 973 698.93	R 976 681.16	R 934 739.19
1979-01	R 953 648.73	R 885 560.95	R 834 272.59	R 973 676.84	R 887 029.26	R 831 386.90	R 936 193.16	R 925 967.14	R 899 782.07
1980-01	R 905 890.88	R 841 705.23	R 798 297.93	R 910 058.20	R 834 962.81	R 787 885.36	R 896 976.16	R 888 964.15	R 865 534.14
1981-01	R 1 087 701.67	R 961 727.44	R 891 791.64	R 1 124 900.90	R 966 231.31	R 890 023.97	R 1 003 359.61	R 958 183.37	R 918 540.53
1982-01	R 1 224 622.31	R 1 139 381.82	R 1 037 996.38	R 1 282 643.74	R 1 177 115.35	R 1 049 133.25	R 1 166 808.24	R 1 087 478.46	R 1 012 615.98
1983-01	R 1 097 810.48	R 1 008 853.31	R 888 314.72	R 1 115 023.36	R 1 006 277.11	R 878 542.43	R 989 073.10	R 966 651.57	R 917 969.22
1984-01	R 1 332 391.82	R 1 186 719.59	R 1 036 762.98	R 1 423 877.70	R 1 230 775.03	R 1 046 039.70	R 1 241 827.80	R 1 116 028.42	R 1 007 157.56
1985-01	R 1 597 404.60	R 1 345 074.19	R 1 137 657.16	R 1 772 604.65	R 1 418 355.96	R 1 153 247.92	R 1 582 200.14	R 1 323 639.13	R 1 129 211.37
1986-01	R 1 718 436.69	R 1 482 212.44	R 1 277 787.87	R 1 883 165.57	R 1 567 990.29	R 1 311 204.33	R 1 696 607.93	R 1 449 585.53	R 1 249 369.40
1987-01	R 1 523 972.46	R 1 394 991.31	R 1 186 956.61	R 1 591 579.51	R 1 438 350.27	R 1 193 189.45	R 1 447 478.36	R 1 308 459.55	R 1 130 642.14
1988-01	R 1 641 020.13	R 1 587 754.98	R 1 307 460.75	R 1 742 347.75	R 1 708 879.07	R 1 346 177.43	R 1 649 513.10	R 1 580 249.32	R 1 289 467.22
1989-01	R 1 752 621.07	R 1 711 726.42	R 1 379 732.74	R 1 847 171.19	R 1 826 882.78	R 1 410 497.55	R 1 757 238.57	R 1 699 646.88	R 1 361 028.41

Table A.3B: Present values of composite annuity strategies – asset allocation B with life annuity (0%)

	Composite with life annuity (0%)								
Asset allocation	B								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-B-a-55-0%]	C[Liv-B-a-60-0%]	C[Liv-B-a-65-0%]	C[Liv-B-b-55-0%]	C[Liv-B-b-60-0%]	C[Liv-B-b-65-0%]	C[Liv-B-c-55-0%]	C[Liv-B-c-60-0%]	C[Liv-B-c-65-0%]
1960-01	R 1 218 373.86	R 1 163 780.49	R 1 223 905.71	R 1 213 031.46	R 1 213 906.62	R 1 223 102.52	R 1 208 008.91	R 1 194 246.02	R 1 212 396.20
1961-01	R 1 236 283.98	R 1 233 057.69	R 1 218 307.15	R 1 229 363.97	R 1 239 424.35	R 1 233 244.58	R 1 227 640.62	R 1 228 053.04	R 1 223 967.35
1962-01	R 1 277 060.54	R 1 267 283.49	R 1 177 888.31	R 1 246 858.40	R 1 240 819.11	R 1 197 995.01	R 1 244 745.79	R 1 239 613.72	R 1 186 440.12
1963-01	R 1 074 050.22	R 1 084 948.43	R 1 007 331.10	R 1 056 407.20	R 1 082 751.27	R 1 061 352.74	R 1 079 918.60	R 1 107 690.79	R 1 057 804.25
1964-01	R 962 597.16	R 981 622.75	R 938 842.89	R 962 691.83	R 988 801.59	R 985 321.75	R 1 023 712.61	R 1 046 435.64	R 1 013 833.77
1965-01	R 976 688.00	R 1 024 124.18	R 967 028.40	R 962 996.25	R 996 236.23	R 990 965.80	R 1 019 128.38	R 1 052 680.51	R 1 026 170.73
1966-01	R 1 036 464.06	R 1 011 706.94	R 1 021 123.89	R 1 000 315.00	R 993 015.55	R 1 007 699.81	R 1 038 602.61	R 1 047 211.43	R 1 051 195.10
1967-01	R 990 873.63	R 990 186.88	R 999 926.34	R 978 089.85	R 983 846.08	R 994 250.42	R 1 031 365.47	R 1 043 133.61	R 1 043 161.91
1968-01	R 919 640.87	R 917 582.37	R 900 486.16	R 898 269.99	R 902 280.71	R 900 017.85	R 978 344.75	R 991 676.90	R 977 194.19
1969-01	R 821 423.84	R 826 285.13	R 817 654.45	R 778 959.92	R 794 644.56	R 801 842.49	R 931 702.76	R 944 437.92	R 928 959.14
1970-01	R 814 405.73	R 807 142.46	R 810 095.82	R 797 855.68	R 796 097.91	R 796 186.62	R 882 153.21	R 891 560.89	R 884 619.69
1971-01	R 976 704.97	R 961 502.58	R 916 935.91	R 971 654.77	R 952 492.22	R 909 708.90	R 966 763.38	R 969 570.66	R 940 947.90
1972-01	R 1 017 290.54	R 1 033 206.56	R 965 527.32	R 1 015 689.17	R 1 031 021.70	R 956 170.89	R 997 270.88	R 1 007 063.25	R 971 178.60
1973-01	R 896 047.17	R 842 221.62	R 857 477.99	R 885 084.93	R 828 277.31	R 831 626.09	R 897 318.16	R 893 141.23	R 887 042.30
1974-01	R 886 206.08	R 860 972.97	R 815 430.20	R 870 834.29	R 842 600.74	R 802 620.15	R 910 538.25	R 912 787.13	R 886 736.16
1975-01	R 1 043 701.82	R 952 077.80	R 913 281.15	R 1 063 489.11	R 947 184.33	R 903 480.73	R 976 478.34	R 941 008.76	R 919 703.40
1976-01	R 1 170 918.78	R 1 133 123.94	R 1 077 250.44	R 1 201 270.58	R 1 158 172.80	R 1 083 072.01	R 1 142 567.84	R 1 100 790.23	R 1 051 023.68
1977-01	R 1 336 746.17	R 1 239 762.92	R 1 148 907.77	R 1 403 158.99	R 1 267 841.15	R 1 150 252.64	R 1 356 712.57	R 1 246 792.16	R 1 150 784.56
1978-01	R 1 231 001.99	R 1 261 504.66	R 1 120 739.65	R 1 260 934.89	R 1 332 477.32	R 1 131 857.77	R 1 236 189.85	R 1 258 500.47	R 1 120 033.60
1979-01	R 1 195 683.56	R 1 108 932.36	R 1 012 433.76	R 1 266 279.89	R 1 142 040.10	R 1 017 866.57	R 1 156 225.23	R 1 082 170.15	R 1 004 127.91
1980-01	R 1 027 865.32	R 953 991.07	R 902 342.56	R 1 063 195.52	R 964 810.83	R 902 222.23	R 952 076.44	R 927 080.77	R 904 149.35
1981-01	R 1 158 270.37	R 1 015 319.10	R 957 697.71	R 1 214 822.78	R 1 021 979.39	R 960 132.20	R 1 103 653.32	R 999 788.44	R 947 528.66
1982-01	R 1 283 717.29	R 1 227 365.77	R 1 136 225.28	R 1 341 192.98	R 1 281 599.93	R 1 164 434.82	R 1 266 747.47	R 1 201 232.72	R 1 110 258.75
1983-01	R 1 156 695.76	R 1 079 383.93	R 967 271.58	R 1 194 075.69	R 1 094 215.84	R 962 377.74	R 1 063 481.59	R 1 015 425.86	R 956 750.34
1984-01	R 1 367 570.79	R 1 241 005.65	R 1 091 001.74	R 1 467 910.32	R 1 299 165.69	R 1 105 696.78	R 1 324 189.62	R 1 199 370.23	R 1 068 014.34
1985-01	R 1 672 652.29	R 1 362 728.20	R 1 176 646.08	R 1 881 365.88	R 1 424 437.56	R 1 187 077.79	R 1 707 165.05	R 1 364 128.30	R 1 176 307.21
1986-01	R 1 764 797.24	R 1 453 881.22	R 1 287 844.96	R 1 959 368.06	R 1 526 775.88	R 1 319 992.07	R 1 749 614.59	R 1 431 754.84	R 1 264 908.58
1987-01	R 1 537 951.08	R 1 338 952.77	R 1 162 767.63	R 1 603 719.53	R 1 363 338.75	R 1 161 430.75	R 1 429 311.54	R 1 252 684.53	R 1 117 358.35
1988-01	R 1 656 752.62	R 1 607 923.76	R 1 315 077.69	R 1 770 902.77	R 1 757 964.56	R 1 360 481.52	R 1 685 033.10	R 1 628 849.22	R 1 312 173.56
1989-01	R 1 792 334.41	R 1 754 087.28	R 1 347 062.14	R 1 905 050.90	R 1 890 323.51	R 1 368 453.27	R 1 799 996.35	R 1 741 001.54	R 1 336 599.34

Table A.3C: Present values of composite annuity strategies – asset allocation C with life annuity (0%)

	Composite with life annuity (0%)								
Asset allocation	C								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-C-a-55-0%]	C[Liv-C-a-60-0%]	C[Liv-C-a-65-0%]	C[Liv-C-b-55-0%]	C[Liv-C-b-60-0%]	C[Liv-C-b-65-0%]	C[Liv-C-c-55-0%]	C[Liv-C-c-60-0%]	C[Liv-C-c-65-0%]
1960-01	R 1 432 159.20	R 1 277 118.26	R 1 364 047.52	R 1 361 095.40	R 1 295 123.46	R 1 324 370.67	R 1 394 212.87	R 1 270 928.86	R 1 337 908.27
1961-01	R 1 526 839.24	R 1 427 290.07	R 1 399 924.25	R 1 514 406.82	R 1 416 127.51	R 1 400 615.06	R 1 531 274.84	R 1 417 339.73	R 1 399 926.45
1962-01	R 1 601 525.81	R 1 510 226.39	R 1 328 132.51	R 1 606 671.89	R 1 495 395.83	R 1 330 983.20	R 1 615 675.05	R 1 504 257.99	R 1 323 573.22
1963-01	R 1 334 385.15	R 1 299 952.04	R 1 117 646.85	R 1 294 549.35	R 1 256 959.02	R 1 143 286.59	R 1 298 132.20	R 1 261 990.79	R 1 129 032.47
1964-01	R 1 167 338.48	R 1 158 076.25	R 1 032 690.60	R 1 127 155.54	R 1 114 845.86	R 1 059 513.58	R 1 124 141.57	R 1 125 486.81	R 1 065 935.95
1965-01	R 1 193 873.78	R 1 214 453.96	R 1 059 214.05	R 1 138 171.58	R 1 132 021.94	R 1 060 381.86	R 1 128 361.74	R 1 134 064.88	R 1 077 238.79
1966-01	R 1 292 257.73	R 1 182 529.28	R 1 143 066.08	R 1 240 646.98	R 1 136 087.54	R 1 098 522.59	R 1 188 300.90	R 1 120 033.02	R 1 121 379.88
1967-01	R 1 157 749.56	R 1 129 793.06	R 1 108 753.92	R 1 115 058.44	R 1 088 843.82	R 1 068 931.58	R 1 108 722.56	R 1 092 370.18	R 1 098 756.28
1968-01	R 1 086 097.22	R 1 060 561.47	R 993 395.20	R 1 032 705.49	R 1 002 334.41	R 960 193.89	R 1 023 978.15	R 1 031 368.00	R 1 017 324.58
1969-01	R 945 697.02	R 933 438.41	R 875 578.09	R 824 589.00	R 833 075.20	R 822 585.54	R 950 661.53	R 967 087.29	R 948 667.03
1970-01	R 948 019.81	R 915 900.59	R 898 977.22	R 908 927.35	R 877 459.92	R 850 734.78	R 902 174.99	R 902 500.07	R 902 946.49
1971-01	R 1 244 550.24	R 1 190 129.71	R 1 080 316.34	R 1 257 583.99	R 1 190 858.44	R 1 066 517.27	R 1 205 537.93	R 1 146 960.99	R 1 049 550.25
1972-01	R 1 268 541.46	R 1 318 358.37	R 1 168 136.95	R 1 277 232.20	R 1 352 474.05	R 1 164 482.95	R 1 240 990.94	R 1 265 047.95	R 1 125 728.62
1973-01	R 1 069 234.49	R 975 395.33	R 1 008 167.44	R 1 057 623.69	R 944 760.91	R 961 862.92	R 970 746.16	R 931 390.65	R 932 454.47
1974-01	R 1 084 911.23	R 1 040 493.84	R 940 258.32	R 1 054 962.89	R 1 001 005.27	R 898 631.94	R 989 877.39	R 975 911.89	R 932 264.12
1975-01	R 1 269 715.35	R 1 106 603.44	R 1 056 306.24	R 1 310 306.27	R 1 093 676.99	R 1 038 620.33	R 1 213 736.60	R 1 069 094.84	R 1 011 409.03
1976-01	R 1 485 985.65	R 1 411 738.19	R 1 354 274.02	R 1 545 298.43	R 1 464 028.03	R 1 393 497.61	R 1 501 143.39	R 1 410 460.32	R 1 336 313.30
1977-01	R 1 710 983.10	R 1 597 376.92	R 1 431 682.13	R 1 809 238.76	R 1 669 080.35	R 1 443 655.13	R 1 804 799.41	R 1 662 435.64	R 1 447 745.93
1978-01	R 1 521 512.50	R 1 621 130.34	R 1 408 663.91	R 1 551 158.87	R 1 764 312.62	R 1 450 350.06	R 1 555 010.26	R 1 713 214.21	R 1 435 600.16
1979-01	R 1 484 229.73	R 1 390 924.55	R 1 231 286.63	R 1 591 605.65	R 1 461 914.75	R 1 245 812.92	R 1 529 361.29	R 1 413 650.84	R 1 236 450.98
1980-01	R 1 149 471.38	R 1 072 543.15	R 1 018 269.67	R 1 201 339.70	R 1 095 004.29	R 1 032 978.61	R 1 110 906.57	R 1 044 192.10	R 987 689.17
1981-01	R 1 215 434.99	R 1 061 945.20	R 1 024 853.96	R 1 278 930.55	R 1 062 211.68	R 1 034 242.37	R 1 198 400.72	R 1 057 354.56	R 1 012 948.87
1982-01	R 1 324 577.29	R 1 305 732.76	R 1 237 325.66	R 1 364 004.71	R 1 366 037.91	R 1 285 814.22	R 1 329 132.12	R 1 303 126.73	R 1 225 559.90
1983-01	R 1 196 056.13	R 1 137 239.82	R 1 045 884.05	R 1 236 432.65	R 1 161 680.62	R 1 046 895.55	R 1 143 282.67	R 1 085 616.97	R 1 012 468.75
1984-01	R 1 376 118.65	R 1 276 233.58	R 1 134 546.31	R 1 467 780.10	R 1 336 437.39	R 1 149 251.50	R 1 363 455.66	R 1 256 979.27	R 1 122 703.14
1985-01	R 1 709 206.80	R 1 358 238.13	R 1 201 821.52	R 1 931 861.89	R 1 394 894.69	R 1 199 408.55	R 1 778 386.59	R 1 366 692.94	R 1 202 978.75
1986-01	R 1 769 148.28	R 1 404 189.44	R 1 279 879.71	R 1 974 018.96	R 1 456 215.88	R 1 306 126.26	R 1 745 144.75	R 1 386 798.46	R 1 260 412.86
1987-01	R 1 517 113.20	R 1 266 756.71	R 1 124 017.00	R 1 563 519.91	R 1 272 088.03	R 1 115 546.40	R 1 362 409.40	R 1 193 482.52	R 1 099 628.61
1988-01	R 1 631 181.62	R 1 595 667.58	R 1 303 930.83	R 1 738 372.58	R 1 758 513.36	R 1 348 142.59	R 1 664 991.83	R 1 632 114.49	R 1 309 287.42
1989-01	R 1 782 355.73	R 1 757 457.58	R 1 298 693.39	R 1 892 390.41	R 1 894 558.79	R 1 308 249.53	R 1 778 309.75	R 1 726 176.29	R 1 294 357.42

Table A.3D: Present values of composite annuity strategies – asset allocation A with life annuity (5%)

	Composite with life annuity (5%)								
Asset allocation	A								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-A-a-55-5%]	C[Liv-A-a-60-5%]	C[Liv-A-a-65-5%]	C[Liv-A-b-55-5%]	C[Liv-A-b-60-5%]	C[Liv-A-b-65-5%]	C[Liv-A-c-55-5%]	C[Liv-A-c-60-5%]	C[Liv-A-c-65-5%]
1960-01	R 1 000 806.33	R 1 015 678.93	R 1 058 136.23	R 1 057 175.77	R 1 086 109.36	R 1 090 791.83	R 1 084 757.68	R 1 098 608.28	R 1 093 796.94
1961-01	R 976 165.52	R 1 028 053.09	R 1 024 930.70	R 1 030 109.04	R 1 072 062.09	R 1 070 660.32	R 1 056 665.38	R 1 088 601.13	R 1 065 499.01
1962-01	R 998 030.59	R 1 034 324.35	R 1 005 553.02	R 1 017 679.70	R 1 057 654.26	R 1 051 610.61	R 1 057 301.52	R 1 085 299.54	R 1 049 671.87
1963-01	R 826 881.28	R 867 373.09	R 859 240.82	R 873 738.45	R 916 596.90	R 924 793.81	R 961 149.35	R 987 599.12	R 963 849.06
1964-01	R 750 468.54	R 791 322.77	R 803 777.33	R 803 615.11	R 845 938.77	R 861 879.37	R 922 307.51	R 945 851.43	R 929 779.05
1965-01	R 757 959.85	R 820 911.49	R 829 976.28	R 804 290.28	R 851 729.59	R 871 886.17	R 917 605.47	R 947 970.50	R 935 954.76
1966-01	R 802 349.79	R 825 858.19	R 864 918.24	R 822 337.33	R 855 941.57	R 885 558.70	R 934 353.15	R 953 674.91	R 951 257.05
1967-01	R 801 555.39	R 825 012.88	R 854 496.30	R 827 773.41	R 860 145.53	R 882 522.16	R 938 568.57	R 957 123.20	R 949 662.30
1968-01	R 735 786.29	R 755 593.47	R 770 756.16	R 754 469.56	R 785 281.56	R 802 602.68	R 893 963.77	R 910 551.77	R 896 528.76
1969-01	R 670 760.25	R 693 704.34	R 717 958.17	R 684 146.94	R 713 521.62	R 735 758.72	R 857 807.74	R 873 949.73	R 862 428.79
1970-01	R 653 635.59	R 669 134.71	R 689 336.76	R 664 105.89	R 690 969.02	R 710 207.17	R 820 769.13	R 836 068.37	R 826 116.49
1971-01	R 742 946.33	R 754 419.15	R 749 744.83	R 743 624.29	R 758 371.59	R 764 182.54	R 862 569.09	R 874 130.42	R 855 548.24
1972-01	R 785 720.90	R 795 388.86	R 776 493.81	R 782 465.92	R 791 867.06	R 781 613.43	R 879 997.97	R 889 936.65	R 867 477.53
1973-01	R 714 226.33	R 693 914.82	R 706 058.49	R 704 304.76	R 695 628.55	R 707 345.24	R 826 831.76	R 831 404.09	R 817 312.55
1974-01	R 690 851.24	R 685 810.10	R 676 586.34	R 686 175.65	R 686 005.77	R 685 604.01	R 822 293.63	R 827 126.48	R 807 592.64
1975-01	R 826 483.16	R 786 408.99	R 762 942.78	R 826 564.32	R 783 914.94	R 763 679.52	R 868 901.12	R 866 613.57	R 844 689.99
1976-01	R 899 044.63	R 886 260.81	R 844 022.96	R 905 573.12	R 887 813.86	R 841 414.53	R 915 251.12	R 917 661.10	R 895 164.39
1977-01	R 1 019 905.17	R 946 402.16	R 903 125.38	R 1 047 863.90	R 949 102.54	R 899 226.64	R 979 227.72	R 949 511.10	R 921 579.09
1978-01	R 963 556.40	R 958 265.47	R 871 932.08	R 977 994.39	R 975 005.86	R 868 970.44	R 943 645.97	R 944 233.69	R 900 874.35
1979-01	R 917 131.51	R 848 626.56	R 797 552.59	R 937 159.62	R 850 094.87	R 794 666.90	R 899 675.94	R 889 032.75	R 863 062.07
1980-01	R 870 059.65	R 804 978.80	R 761 219.26	R 874 226.97	R 798 236.38	R 750 806.69	R 861 144.93	R 852 237.72	R 828 455.47
1981-01	R 1 073 966.52	R 939 423.11	R 862 588.52	R 1 111 165.75	R 943 926.98	R 860 820.85	R 989 624.46	R 935 879.04	R 889 337.41
1982-01	R 1 224 890.40	R 1 126 508.06	R 1 013 709.64	R 1 282 911.83	R 1 164 241.59	R 1 024 846.51	R 1 167 076.33	R 1 074 604.70	R 988 329.24
1983-01	R 1 076 009.96	R 981 380.91	R 855 490.25	R 1 093 222.84	R 978 804.71	R 845 717.96	R 967 272.58	R 939 179.17	R 885 144.75
1984-01	R 1 342 592.46	R 1 180 822.24	R 1 016 108.96	R 1 434 078.34	R 1 224 877.68	R 1 025 385.68	R 1 252 028.44	R 1 110 131.07	R 986 503.54
1985-01	R 1 640 141.42	R 1 360 536.55	R 1 128 958.02	R 1 815 341.47	R 1 433 818.32	R 1 144 548.78	R 1 624 936.96	R 1 339 101.49	R 1 120 512.23
1986-01	R 1 779 873.85	R 1 509 235.79	R 1 274 875.44	R 1 944 602.73	R 1 595 013.64	R 1 308 291.90	R 1 758 045.09	R 1 476 608.88	R 1 246 456.97
1987-01	R 1 567 089.91	R 1 409 764.53	R 1 176 486.40	R 1 634 696.96	R 1 453 123.49	R 1 182 719.24	R 1 490 595.81	R 1 323 232.77	R 1 120 171.93
1988-01	R 1 704 428.78	R 1 616 515.24	R 1 304 099.07	R 1 805 756.40	R 1 737 639.33	R 1 342 815.75	R 1 712 921.75	R 1 609 009.58	R 1 286 105.54
1989-01	R 1 830 709.98	R 1 751 521.97	R 1 381 817.68	R 1 925 260.10	R 1 866 678.33	R 1 412 582.49	R 1 835 327.48	R 1 739 442.43	R 1 363 113.35

Table A.3E: Present values of composite annuity strategies – asset allocation B with life annuity (5%)

	Composite with life annuity (5%)								
Asset allocation	B								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-B-a-55-5%]	C[Liv-B-a-60-5%]	C[Liv-B-a-65-5%]	C[Liv-B-b-55-5%]	C[Liv-B-b-60-5%]	C[Liv-B-b-65-5%]	C[Liv-B-c-55-5%]	C[Liv-B-c-60-5%]	C[Liv-B-c-65-5%]
1960-01	R 1 161 101.75	R 1 115 124.92	R 1 177 353.65	R 1 155 759.35	R 1 165 251.05	R 1 176 550.46	R 1 150 736.80	R 1 145 590.45	R 1 165 844.14
1961-01	R 1 178 218.46	R 1 183 554.33	R 1 171 836.41	R 1 171 298.45	R 1 189 920.99	R 1 186 773.84	R 1 169 575.10	R 1 178 549.68	R 1 177 496.61
1962-01	R 1 221 944.37	R 1 220 028.24	R 1 133 154.67	R 1 191 742.23	R 1 193 563.86	R 1 153 261.37	R 1 189 629.62	R 1 192 358.47	R 1 141 706.48
1963-01	R 1 007 395.08	R 1 027 912.55	R 956 288.63	R 989 752.06	R 1 025 715.39	R 1 010 310.27	R 1 013 263.46	R 1 050 654.91	R 1 006 761.78
1964-01	R 896 633.14	R 924 736.67	R 888 304.42	R 896 727.81	R 931 915.51	R 934 783.28	R 957 748.59	R 989 549.56	R 963 295.30
1965-01	R 908 883.50	R 965 216.30	R 914 720.92	R 895 191.75	R 937 328.35	R 938 658.32	R 951 323.88	R 993 772.63	R 973 863.25
1966-01	R 975 504.34	R 958 197.37	R 972 803.48	R 939 355.28	R 939 505.98	R 959 379.40	R 977 642.89	R 993 701.86	R 1 002 874.69
1967-01	R 930 368.37	R 936 783.02	R 951 169.70	R 917 584.59	R 930 442.22	R 945 493.78	R 970 860.21	R 989 729.75	R 994 405.27
1968-01	R 860 817.92	R 865 464.95	R 853 012.67	R 839 447.04	R 850 163.29	R 852 544.36	R 919 521.80	R 939 559.48	R 929 720.70
1969-01	R 763 756.94	R 774 946.44	R 771 020.69	R 721 293.02	R 743 305.87	R 755 208.73	R 874 035.86	R 893 099.23	R 882 325.38
1970-01	R 757 171.80	R 755 934.82	R 763 758.26	R 740 621.75	R 744 890.27	R 749 849.06	R 824 919.28	R 840 353.25	R 838 282.13
1971-01	R 926 150.73	R 915 502.55	R 874 456.35	R 921 100.53	R 906 492.19	R 867 229.34	R 916 209.14	R 923 570.63	R 898 468.34
1972-01	R 970 807.22	R 990 295.29	R 925 260.16	R 969 205.85	R 988 110.43	R 915 903.73	R 950 787.56	R 964 151.98	R 930 911.44
1973-01	R 849 176.37	R 799 052.51	R 817 391.69	R 838 214.13	R 785 108.20	R 791 539.79	R 850 447.36	R 849 972.12	R 846 956.00
1974-01	R 841 030.99	R 819 120.58	R 776 436.68	R 825 659.20	R 800 748.35	R 763 626.63	R 865 363.16	R 870 934.74	R 847 742.64
1975-01	R 1 003 914.76	R 913 635.49	R 876 245.39	R 1 023 702.05	R 908 742.02	R 866 444.97	R 936 691.28	R 902 566.45	R 882 667.64
1976-01	R 1 134 716.15	R 1 096 779.48	R 1 041 316.38	R 1 165 067.95	R 1 121 828.34	R 1 047 137.95	R 1 106 365.21	R 1 064 445.77	R 1 015 089.62
1977-01	R 1 307 215.48	R 1 207 861.52	R 1 115 604.69	R 1 373 628.30	R 1 235 939.75	R 1 116 949.56	R 1 327 181.88	R 1 214 890.76	R 1 117 481.48
1978-01	R 1 200 949.03	R 1 229 057.19	R 1 086 874.81	R 1 230 881.93	R 1 300 029.85	R 1 097 992.93	R 1 206 136.89	R 1 226 053.00	R 1 086 168.76
1979-01	R 1 159 166.34	R 1 071 997.97	R 975 713.76	R 1 229 762.67	R 1 105 105.71	R 981 146.57	R 1 119 708.01	R 1 045 235.76	R 967 407.91
1980-01	R 992 034.09	R 917 264.64	R 865 263.89	R 1 027 364.29	R 928 084.40	R 865 143.56	R 916 245.21	R 890 354.34	R 867 070.68
1981-01	R 1 144 535.22	R 993 014.77	R 928 494.59	R 1 201 087.63	R 999 675.06	R 930 929.08	R 1 089 918.17	R 977 484.11	R 918 325.54
1982-01	R 1 283 985.38	R 1 214 492.01	R 1 111 938.54	R 1 341 461.07	R 1 268 726.17	R 1 140 148.08	R 1 267 015.56	R 1 188 358.96	R 1 085 972.01
1983-01	R 1 134 895.24	R 1 051 911.53	R 934 447.11	R 1 172 275.17	R 1 066 743.44	R 929 553.27	R 1 041 681.07	R 987 953.46	R 923 925.87
1984-01	R 1 377 771.43	R 1 235 108.30	R 1 070 347.72	R 1 478 110.96	R 1 293 268.34	R 1 085 042.76	R 1 334 390.26	R 1 193 472.88	R 1 047 360.32
1985-01	R 1 715 389.11	R 1 378 190.56	R 1 167 946.94	R 1 924 102.70	R 1 439 899.92	R 1 178 378.65	R 1 749 901.87	R 1 379 590.66	R 1 167 608.07
1986-01	R 1 826 234.40	R 1 480 904.57	R 1 284 932.53	R 2 020 805.22	R 1 553 799.23	R 1 317 079.64	R 1 811 051.75	R 1 458 778.19	R 1 261 996.15
1987-01	R 1 581 068.53	R 1 353 725.99	R 1 152 297.42	R 1 646 836.98	R 1 378 111.97	R 1 150 960.54	R 1 472 428.99	R 1 267 457.75	R 1 106 888.14
1988-01	R 1 720 161.27	R 1 636 684.02	R 1 311 716.01	R 1 834 311.42	R 1 786 724.82	R 1 357 119.84	R 1 748 441.75	R 1 657 609.48	R 1 308 811.88
1989-01	R 1 870 423.32	R 1 793 882.83	R 1 349 147.08	R 1 983 139.81	R 1 930 119.06	R 1 370 538.21	R 1 878 085.26	R 1 780 797.09	R 1 338 684.28

Table A.3F: Present values of composite annuity strategies – asset allocation C with life annuity (5%)

	Composite with life annuity (5%)								
Asset allocation	C								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-C-a-55-5%]	C[Liv-C-a-60-5%]	C[Liv-C-a-65-5%]	C[Liv-C-b-55-5%]	C[Liv-C-b-60-5%]	C[Liv-C-b-65-5%]	C[Liv-C-c-55-5%]	C[Liv-C-c-60-5%]	C[Liv-C-c-65-5%]
1960-01	R 1 374 887.09	R 1 228 462.69	R 1 317 495.46	R 1 303 823.29	R 1 246 467.89	R 1 277 818.61	R 1 336 940.76	R 1 222 273.29	R 1 291 356.21
1961-01	R 1 468 773.72	R 1 377 786.71	R 1 353 453.51	R 1 456 341.30	R 1 366 624.15	R 1 354 144.32	R 1 473 209.32	R 1 367 836.37	R 1 353 455.71
1962-01	R 1 546 409.64	R 1 462 971.14	R 1 283 398.87	R 1 551 555.72	R 1 448 140.58	R 1 286 249.56	R 1 560 558.88	R 1 457 002.74	R 1 278 839.58
1963-01	R 1 267 730.01	R 1 242 916.16	R 1 066 604.38	R 1 227 894.21	R 1 199 923.14	R 1 092 244.12	R 1 231 477.06	R 1 204 954.91	R 1 077 990.00
1964-01	R 1 101 374.46	R 1 101 190.17	R 982 152.13	R 1 061 191.52	R 1 057 959.78	R 1 008 975.11	R 1 058 177.55	R 1 068 600.73	R 1 015 397.48
1965-01	R 1 126 069.28	R 1 155 546.08	R 1 006 906.57	R 1 070 367.08	R 1 073 114.06	R 1 008 074.38	R 1 060 557.24	R 1 075 157.00	R 1 024 931.31
1966-01	R 1 231 298.01	R 1 129 019.71	R 1 094 745.67	R 1 179 687.26	R 1 082 577.97	R 1 050 202.18	R 1 127 341.18	R 1 066 523.45	R 1 073 059.47
1967-01	R 1 097 244.30	R 1 076 389.20	R 1 059 997.28	R 1 054 553.18	R 1 035 439.96	R 1 020 174.94	R 1 048 217.30	R 1 038 966.32	R 1 049 999.64
1968-01	R 1 027 274.27	R 1 008 444.05	R 945 921.71	R 973 882.54	R 950 216.99	R 912 720.40	R 965 155.20	R 979 250.58	R 969 851.09
1969-01	R 888 030.12	R 882 099.72	R 828 944.33	R 766 922.10	R 781 736.51	R 775 951.78	R 892 994.63	R 915 748.60	R 902 033.27
1970-01	R 890 785.88	R 864 692.95	R 852 639.66	R 851 693.42	R 826 252.28	R 804 397.22	R 844 941.06	R 851 292.43	R 856 608.93
1971-01	R 1 193 996.00	R 1 144 129.68	R 1 037 836.78	R 1 207 029.75	R 1 144 858.41	R 1 024 037.71	R 1 154 983.69	R 1 100 960.96	R 1 007 070.69
1972-01	R 1 222 058.14	R 1 275 447.10	R 1 127 869.79	R 1 230 748.88	R 1 309 562.78	R 1 124 215.79	R 1 194 507.62	R 1 222 136.68	R 1 085 461.46
1973-01	R 1 022 363.69	R 932 226.22	R 968 081.14	R 1 010 752.89	R 901 591.80	R 921 776.62	R 923 875.36	R 888 221.54	R 892 368.17
1974-01	R 1 039 736.14	R 998 641.45	R 901 264.80	R 1 009 787.80	R 959 152.88	R 859 638.42	R 944 702.30	R 934 059.50	R 893 270.60
1975-01	R 1 229 928.29	R 1 068 161.13	R 1 019 270.48	R 1 270 519.21	R 1 055 234.68	R 1 001 584.57	R 1 173 949.54	R 1 030 652.53	R 974 373.27
1976-01	R 1 449 783.02	R 1 375 393.73	R 1 318 339.96	R 1 509 095.80	R 1 427 683.57	R 1 357 563.55	R 1 464 940.76	R 1 374 115.86	R 1 300 379.24
1977-01	R 1 681 452.41	R 1 565 475.52	R 1 398 379.05	R 1 779 708.07	R 1 637 178.95	R 1 410 352.05	R 1 775 268.72	R 1 630 534.24	R 1 414 442.85
1978-01	R 1 491 459.54	R 1 588 682.87	R 1 374 799.07	R 1 521 105.91	R 1 731 865.15	R 1 416 485.22	R 1 524 957.30	R 1 680 766.74	R 1 401 735.32
1979-01	R 1 447 712.51	R 1 353 990.16	R 1 194 566.63	R 1 555 088.43	R 1 424 980.36	R 1 209 092.92	R 1 492 844.07	R 1 376 716.45	R 1 199 730.98
1980-01	R 1 113 640.15	R 1 035 816.72	R 981 191.00	R 1 165 508.47	R 1 058 277.86	R 995 899.94	R 1 075 075.34	R 1 007 465.67	R 950 610.50
1981-01	R 1 201 699.84	R 1 039 640.87	R 995 650.84	R 1 265 195.40	R 1 039 907.35	R 1 005 039.25	R 1 184 665.57	R 1 035 050.23	R 983 745.75
1982-01	R 1 324 845.38	R 1 292 859.00	R 1 213 038.92	R 1 364 272.80	R 1 353 164.15	R 1 261 527.48	R 1 329 400.21	R 1 290 252.97	R 1 201 273.16
1983-01	R 1 174 255.61	R 1 109 767.42	R 1 013 059.58	R 1 214 632.13	R 1 134 208.22	R 1 014 071.08	R 1 121 482.15	R 1 058 144.57	R 979 644.28
1984-01	R 1 386 319.29	R 1 270 336.23	R 1 113 892.29	R 1 477 980.74	R 1 330 540.04	R 1 128 597.48	R 1 373 656.30	R 1 251 081.92	R 1 102 049.12
1985-01	R 1 751 943.62	R 1 373 700.49	R 1 193 122.38	R 1 974 598.71	R 1 410 357.05	R 1 190 709.41	R 1 821 123.41	R 1 382 155.30	R 1 194 279.61
1986-01	R 1 830 585.44	R 1 431 212.79	R 1 276 967.28	R 2 035 456.12	R 1 483 239.23	R 1 303 213.83	R 1 806 581.91	R 1 413 821.81	R 1 257 500.43
1987-01	R 1 560 230.65	R 1 281 529.93	R 1 113 546.79	R 1 606 637.36	R 1 286 861.25	R 1 105 076.19	R 1 405 526.85	R 1 208 255.74	R 1 089 158.40
1988-01	R 1 694 590.27	R 1 624 427.84	R 1 300 569.15	R 1 801 781.23	R 1 787 273.62	R 1 344 780.91	R 1 728 400.48	R 1 660 874.75	R 1 305 925.74
1989-01	R 1 860 444.64	R 1 797 253.13	R 1 300 778.33	R 1 970 479.32	R 1 934 354.34	R 1 310 334.47	R 1 856 398.66	R 1 765 971.84	R 1 296 442.36

Table A.4A: Present values of switching annuity strategies – asset allocation A to life annuity (0%)

	Switch to life annuity (0%)								
Asset allocation	A								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-A-a-55-0%]	S[Liv-A-a-60-0%]	S[Liv-A-a-65-0%]	S[Liv-A-b-55-0%]	S[Liv-A-b-60-0%]	S[Liv-A-b-65-0%]	S[Liv-A-c-55-0%]	S[Liv-A-c-60-0%]	S[Liv-A-c-65-0%]
1960-01	R 1 011 643.47	R 982 647.60	R 865 684.61	R 1 049 327.16	R 1 039 977.07	R 999 026.24	R 1 025 854.47	R 1 007 994.61	R 933 758.50
1961-01	R 963 994.83	R 946 729.20	R 859 591.75	R 1 003 417.62	R 1 004 340.05	R 975 412.55	R 976 034.79	R 969 583.74	R 917 028.47
1962-01	R 941 658.13	R 929 569.86	R 853 707.38	R 973 192.03	R 976 997.88	R 952 742.65	R 951 687.54	R 949 957.66	R 906 826.93
1963-01	R 837 538.40	R 825 779.99	R 752 648.49	R 890 182.55	R 901 747.23	R 900 555.72	R 872 145.24	R 876 081.00	R 863 299.04
1964-01	R 760 535.64	R 751 907.21	R 690 190.46	R 820 692.83	R 834 323.53	R 834 687.03	R 810 033.46	R 820 276.50	R 818 857.78
1965-01	R 743 539.54	R 736 048.27	R 682 525.71	R 808 013.51	R 823 208.96	R 832 276.76	R 793 338.41	R 804 851.70	R 812 693.24
1966-01	R 744 911.94	R 741 097.04	R 695 393.30	R 795 183.04	R 810 122.33	R 825 606.54	R 792 328.57	R 806 775.56	R 823 668.47
1967-01	R 726 089.76	R 725 841.80	R 687 968.11	R 775 670.94	R 793 739.93	R 813 824.65	R 772 705.73	R 791 082.14	R 811 007.47
1968-01	R 662 898.54	R 662 696.90	R 625 921.18	R 709 612.33	R 727 105.98	R 746 610.88	R 724 956.90	R 752 612.33	R 767 519.48
1969-01	R 573 791.91	R 574 140.26	R 539 925.55	R 631 243.66	R 652 285.82	R 668 461.65	R 659 030.59	R 681 535.55	R 694 509.96
1970-01	R 621 236.03	R 614 803.37	R 564 437.91	R 655 201.41	R 662 546.85	R 659 712.95	R 676 960.23	R 691 576.13	R 692 695.64
1971-01	R 759 243.55	R 742 566.18	R 673 802.50	R 769 619.19	R 761 731.65	R 725 760.39	R 792 122.28	R 793 576.28	R 781 496.50
1972-01	R 770 386.91	R 753 973.18	R 689 656.50	R 775 241.62	R 765 851.89	R 726 727.62	R 805 317.62	R 808 641.04	R 812 307.51
1973-01	R 651 951.75	R 640 702.36	R 585 575.74	R 667 527.13	R 665 502.58	R 644 111.68	R 706 262.44	R 722 187.14	R 721 118.53
1974-01	R 659 331.06	R 639 779.88	R 578 994.46	R 673 242.55	R 663 889.03	R 637 831.70	R 705 372.69	R 715 269.11	R 714 507.90
1975-01	R 750 150.32	R 720 334.44	R 647 382.42	R 752 577.21	R 728 563.45	R 676 310.10	R 781 334.03	R 772 884.69	R 766 616.44
1976-01	R 864 385.83	R 821 175.75	R 728 567.84	R 859 996.75	R 818 569.52	R 736 998.44	R 883 325.80	R 859 551.51	R 835 746.98
1977-01	R 1 027 880.80	R 968 069.93	R 843 536.41	R 1 018 657.39	R 951 871.79	R 815 926.43	R 1 028 325.86	R 979 252.19	R 894 619.31
1978-01	R 992 739.46	R 930 450.26	R 808 984.78	R 984 044.39	R 915 419.02	R 785 389.32	R 994 701.59	R 946 577.07	R 872 932.17
1979-01	R 891 915.09	R 832 206.35	R 720 689.30	R 888 873.23	R 829 994.97	R 728 926.28	R 899 790.10	R 869 005.28	R 834 809.75
1980-01	R 821 476.96	R 756 816.35	R 639 680.09	R 818 922.33	R 759 374.01	R 664 985.46	R 813 452.40	R 789 362.45	R 750 068.30
1981-01	R 922 351.05	R 841 954.04	R 703 161.98	R 921 182.93	R 837 981.81	R 702 201.53	R 915 210.79	R 857 017.37	R 789 079.31
1982-01	R 1 110 325.81	R 1 001 954.39	R 818 398.49	R 1 117 553.45	R 997 837.15	R 797 955.94	R 1 096 514.00	R 1 004 552.45	R 878 287.67
1983-01	R 971 142.91	R 878 306.93	R 715 484.91	R 965 970.13	R 875 922.30	R 733 090.60	R 943 258.16	R 887 289.57	R 823 719.75
1984-01	R 1 180 019.89	R 1 059 392.58	R 839 626.58	R 1 192 558.46	R 1 060 992.13	R 825 223.73	R 1 148 055.23	R 1 046 485.19	R 900 600.52
1985-01	R 1 427 817.65	R 1 254 907.63	R 975 424.06	R 1 471 664.63	R 1 271 047.70	R 937 818.54	R 1 409 453.05	R 1 244 576.57	R 1 006 814.01
1986-01	R 1 472 610.39	R 1 298 578.85	R 1 014 387.25	R 1 508 913.27	R 1 310 908.74	R 983 574.66	R 1 454 624.57	R 1 289 380.62	R 1 049 498.47
1987-01	R 1 342 503.47	R 1 173 463.04	R 908 125.23	R 1 355 624.45	R 1 174 328.48	R 897 833.22	R 1 296 579.05	R 1 148 030.81	R 956 010.19
1988-01	R 1 456 265.80	R 1 282 419.57	R 991 511.77	R 1 495 578.26	R 1 297 687.70	R 962 139.42	R 1 447 878.03	R 1 276 674.71	R 1 015 026.66
1989-01	R 1 573 782.55	R 1 386 321.11	R 1 067 731.53	R 1 612 423.13	R 1 400 504.75	R 1 037 614.07	R 1 562 601.26	R 1 378 805.59	R 1 095 193.27

Table A.4B: Present values of switching annuity strategies – asset allocation B to life annuity (0%)

	Switch to life annuity (0%)								
Asset allocation	B								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-B-a-55-0%]	S[Liv-B-a-60-0%]	S[Liv-B-a-65-0%]	S[Liv-B-b-55-0%]	S[Liv-B-b-60-0%]	S[Liv-B-b-65-0%]	S[Liv-B-c-55-0%]	S[Liv-B-c-60-0%]	S[Liv-B-c-65-0%]
1960-01	R 1 191 858.66	R 1 146 370.15	R 985 168.92	R 1 205 881.27	R 1 175 263.80	R 1 077 780.10	R 1 188 494.16	R 1 149 608.34	R 1 019 446.16
1961-01	R 1 156 407.45	R 1 130 293.58	R 1 014 473.18	R 1 163 584.27	R 1 148 715.51	R 1 068 639.77	R 1 136 573.19	R 1 114 359.11	R 1 010 640.54
1962-01	R 1 121 637.75	R 1 102 259.97	R 1 001 407.41	R 1 122 201.08	R 1 112 028.24	R 1 039 966.64	R 1 100 879.12	R 1 085 174.38	R 995 599.37
1963-01	R 1 043 643.40	R 1 020 017.18	R 909 809.98	R 1 067 950.82	R 1 058 779.48	R 1 004 905.44	R 1 052 803.50	R 1 038 648.48	R 964 446.64
1964-01	R 915 782.37	R 899 617.40	R 812 979.57	R 951 307.18	R 952 022.93	R 923 460.91	R 941 424.12	R 939 342.59	R 902 007.84
1965-01	R 893 010.03	R 877 160.92	R 798 798.56	R 930 077.71	R 931 832.50	R 911 397.51	R 917 489.28	R 915 611.57	R 883 383.21
1966-01	R 853 694.22	R 846 301.09	R 787 646.44	R 882 411.07	R 889 805.39	R 875 895.79	R 879 995.93	R 886 910.87	R 871 746.38
1967-01	R 796 457.58	R 794 749.90	R 750 241.00	R 831 537.70	R 845 704.32	R 849 271.81	R 828 961.00	R 842 910.37	R 850 353.44
1968-01	R 722 062.79	R 719 723.19	R 675 217.12	R 757 439.73	R 770 123.56	R 780 702.87	R 768 564.72	R 793 812.74	R 807 301.45
1969-01	R 581 806.58	R 579 775.98	R 540 068.79	R 637 680.72	R 656 915.64	R 670 955.99	R 664 606.66	R 685 634.25	R 696 828.37
1970-01	R 710 208.42	R 694 211.09	R 618 580.36	R 723 517.24	R 717 711.18	R 688 379.90	R 732 720.02	R 737 585.25	R 721 912.83
1971-01	R 996 241.58	R 957 099.45	R 832 563.17	R 987 761.66	R 950 980.80	R 845 300.23	R 991 616.09	R 963 530.06	R 893 951.13
1972-01	R 1 000 742.63	R 963 914.96	R 850 192.08	R 988 558.61	R 952 649.50	R 849 682.08	R 1 003 336.42	R 978 536.52	R 915 740.49
1973-01	R 783 573.22	R 759 233.11	R 671 371.37	R 780 662.33	R 761 875.08	R 702 087.55	R 797 196.07	R 793 531.08	R 774 968.30
1974-01	R 835 435.41	R 797 777.14	R 696 666.99	R 827 170.61	R 796 220.76	R 726 602.68	R 842 614.22	R 826 089.44	R 801 791.44
1975-01	R 928 826.20	R 877 443.49	R 761 395.75	R 915 460.14	R 864 155.11	R 756 733.38	R 931 762.47	R 895 091.48	R 831 710.35
1976-01	R 1 185 073.56	R 1 104 691.90	R 941 170.97	R 1 173 423.19	R 1 084 306.37	R 906 620.81	R 1 179 779.77	R 1 108 504.29	R 983 288.78
1977-01	R 1 494 932.86	R 1 382 714.66	R 1 157 645.82	R 1 504 486.01	R 1 369 283.11	R 1 084 701.24	R 1 498 260.73	R 1 379 429.19	R 1 148 935.89
1978-01	R 1 380 884.81	R 1 278 818.77	R 1 083 250.03	R 1 371 326.34	R 1 249 524.66	R 1 001 946.46	R 1 379 368.63	R 1 274 813.02	R 1 084 640.53
1979-01	R 1 231 966.09	R 1 137 478.03	R 962 932.36	R 1 226 903.99	R 1 117 239.21	R 913 368.39	R 1 231 037.99	R 1 146 400.91	R 1 010 373.51
1980-01	R 1 045 957.08	R 952 223.29	R 783 852.56	R 1 045 280.24	R 947 255.61	R 779 379.71	R 1 025 939.23	R 953 666.74	R 861 420.30
1981-01	R 1 036 200.65	R 940 575.38	R 775 797.18	R 1 035 915.42	R 930 565.89	R 752 163.56	R 1 028 839.01	R 947 708.75	R 832 965.97
1982-01	R 1 290 649.04	R 1 156 819.92	R 930 480.46	R 1 307 776.66	R 1 154 307.40	R 891 832.35	R 1 281 820.76	R 1 156 384.33	R 968 853.68
1983-01	R 1 081 857.12	R 978 727.54	R 797 304.22	R 1 078 149.39	R 972 123.22	R 796 170.38	R 1 062 926.29	R 986 352.69	R 893 315.76
1984-01	R 1 298 764.94	R 1 164 408.14	R 919 373.78	R 1 319 300.07	R 1 167 818.65	R 889 935.57	R 1 275 199.11	R 1 153 631.84	R 964 645.53
1985-01	R 1 635 884.80	R 1 428 703.94	R 1 093 731.39	R 1 705 157.44	R 1 463 300.46	R 1 049 733.46	R 1 630 492.33	R 1 421 964.90	R 1 107 752.35
1986-01	R 1 542 692.25	R 1 357 731.29	R 1 055 332.01	R 1 583 896.19	R 1 372 403.40	R 1 020 815.56	R 1 525 668.70	R 1 347 328.50	R 1 084 618.60
1987-01	R 1 366 055.11	R 1 191 797.97	R 917 903.73	R 1 372 754.97	R 1 188 193.04	R 908 680.40	R 1 308 960.11	R 1 158 048.43	R 965 664.40
1988-01	R 1 476 299.43	R 1 304 954.68	R 1 017 181.01	R 1 516 561.79	R 1 316 719.29	R 971 833.97	R 1 479 837.92	R 1 305 460.45	R 1 029 999.11
1989-01	R 1 534 127.67	R 1 361 179.67	R 1 065 748.69	R 1 562 391.95	R 1 365 443.85	R 1 025 666.66	R 1 528 026.35	R 1 358 733.10	R 1 095 020.12

Table A.4C: Present values of switching annuity strategies – asset allocation C to life annuity (0%)

	Switch to life annuity (0%)								
Asset allocation	C								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-C-a-55-0%]	S[Liv-C-a-60-0%]	S[Liv-C-a-65-0%]	S[Liv-C-b-55-0%]	S[Liv-C-b-60-0%]	S[Liv-C-b-65-0%]	S[Liv-C-c-55-0%]	S[Liv-C-c-60-0%]	S[Liv-C-c-65-0%]
1960-01	R 1 397 700.62	R 1 333 263.56	R 1 121 317.90	R 1 384 947.04	R 1 329 993.14	R 1 170 084.71	R 1 374 156.41	R 1 311 195.79	R 1 117 141.31
1961-01	R 1 376 662.22	R 1 341 313.33	R 1 194 415.81	R 1 343 559.32	R 1 311 385.87	R 1 174 215.05	R 1 316 728.68	R 1 277 230.83	R 1 116 443.64
1962-01	R 1 324 275.03	R 1 297 360.94	R 1 169 667.06	R 1 288 026.53	R 1 262 666.88	R 1 139 234.28	R 1 266 749.99	R 1 235 856.93	R 1 094 885.72
1963-01	R 1 284 955.43	R 1 247 061.99	R 1 092 522.86	R 1 284 902.37	R 1 254 479.10	R 1 132 147.82	R 1 272 563.56	R 1 237 230.26	R 1 095 742.66
1964-01	R 1 087 524.31	R 1 063 051.17	R 948 818.42	R 1 099 248.19	R 1 086 456.08	R 1 015 664.65	R 1 090 045.11	R 1 074 452.29	R 993 726.12
1965-01	R 1 057 584.36	R 1 032 181.24	R 925 683.75	R 1 069 733.02	R 1 056 559.63	R 994 076.38	R 1 059 234.86	R 1 042 478.75	R 967 632.26
1966-01	R 961 015.66	R 950 509.64	R 879 889.33	R 967 876.26	R 968 166.20	R 931 125.19	R 965 834.11	R 965 655.00	R 927 257.71
1967-01	R 858 073.32	R 855 597.62	R 806 316.44	R 879 026.50	R 890 211.02	R 881 922.09	R 876 745.41	R 887 722.85	R 880 111.12
1968-01	R 771 447.16	R 767 401.85	R 716 604.40	R 797 018.23	R 806 430.13	R 805 922.02	R 807 769.23	R 827 619.34	R 836 931.22
1969-01	R 582 023.01	R 578 069.78	R 534 321.08	R 635 811.07	R 655 368.52	R 666 985.40	R 662 860.51	R 682 449.36	R 692 455.74
1970-01	R 800 427.12	R 774 107.25	R 671 566.49	R 796 427.69	R 776 903.37	R 717 092.25	R 795 519.99	R 784 905.12	R 749 251.69
1971-01	R 1 294 867.68	R 1 225 370.11	R 1 026 347.06	R 1 282 415.33	R 1 208 294.90	R 1 009 520.78	R 1 264 320.79	R 1 198 126.08	R 1 039 971.45
1972-01	R 1 282 315.28	R 1 218 596.63	R 1 040 575.85	R 1 263 036.17	R 1 193 569.03	R 1 008 261.87	R 1 259 481.43	R 1 200 725.88	R 1 059 729.33
1973-01	R 933 636.95	R 893 907.51	R 767 791.45	R 911 811.67	R 873 610.29	R 769 397.03	R 910 303.85	R 882 256.82	R 826 758.42
1974-01	R 1 048 728.11	R 988 131.93	R 836 287.49	R 1 011 201.36	R 952 879.81	R 828 959.82	R 1 005 389.25	R 961 569.09	R 892 760.31
1975-01	R 1 139 725.51	R 1 062 228.95	R 894 133.74	R 1 110 136.64	R 1 026 278.92	R 853 362.04	R 1 112 266.19	R 1 042 702.15	R 915 743.21
1976-01	R 1 612 538.99	R 1 479 968.98	R 1 217 299.72	R 1 605 311.78	R 1 453 610.77	R 1 142 830.10	R 1 594 453.05	R 1 457 873.99	R 1 203 859.54
1977-01	R 2 150 437.85	R 1 960 111.36	R 1 585 810.66	R 2 202 601.01	R 1 977 978.87	R 1 484 983.45	R 2 199 944.43	R 1 980 454.98	R 1 535 715.34
1978-01	R 1 882 282.53	R 1 727 147.64	R 1 432 769.55	R 1 875 139.36	R 1 683 722.19	R 1 286 176.96	R 1 890 803.79	R 1 712 313.07	R 1 367 994.00
1979-01	R 1 661 281.21	R 1 521 034.49	R 1 263 646.72	R 1 657 932.14	R 1 488 055.92	R 1 154 061.98	R 1 663 943.38	R 1 514 213.07	R 1 246 652.25
1980-01	R 1 315 907.60	R 1 185 953.23	R 953 763.07	R 1 328 591.88	R 1 183 334.69	R 924 153.07	R 1 294 839.19	R 1 175 764.31	R 992 042.73
1981-01	R 1 154 089.98	R 1 043 202.49	R 852 294.09	R 1 152 655.96	R 1 026 959.55	R 804 785.27	R 1 147 401.16	R 1 042 915.55	R 882 321.26
1982-01	R 1 484 515.82	R 1 323 418.02	R 1 051 213.09	R 1 509 942.51	R 1 324 121.73	R 993 989.05	R 1 483 783.71	R 1 322 302.75	R 1 068 244.76
1983-01	R 1 187 053.38	R 1 075 697.31	R 879 091.70	R 1 181 296.97	R 1 061 221.98	R 855 372.02	R 1 174 831.30	R 1 084 268.92	R 957 202.96
1984-01	R 1 406 117.82	R 1 260 406.29	R 994 278.52	R 1 432 894.00	R 1 264 046.77	R 948 672.54	R 1 390 778.15	R 1 251 699.00	R 1 024 521.88
1985-01	R 1 836 441.82	R 1 596 165.06	R 1 207 606.51	R 1 934 520.76	R 1 651 439.02	R 1 160 525.12	R 1 849 287.23	R 1 598 267.91	R 1 208 775.68
1986-01	R 1 584 247.96	R 1 393 389.38	R 1 081 022.26	R 1 627 396.57	R 1 408 500.56	R 1 043 375.07	R 1 567 196.12	R 1 381 726.25	R 1 106 384.31
1987-01	R 1 362 776.70	R 1 188 024.38	R 913 077.94	R 1 360 556.95	R 1 178 551.56	R 906 008.63	R 1 293 374.51	R 1 145 828.41	R 962 702.33
1988-01	R 1 464 901.11	R 1 301 511.72	R 1 026 035.83	R 1 497 842.60	R 1 304 041.19	R 962 801.57	R 1 473 802.06	R 1 303 034.64	R 1 026 599.84
1989-01	R 1 463 399.31	R 1 309 672.62	R 1 045 536.36	R 1 477 837.75	R 1 301 999.26	R 997 229.88	R 1 459 582.73	R 1 310 892.95	R 1 078 789.74

Table A.4D: Present values of switching annuity strategies – asset allocation A to life annuity (5%)

	Switch to life annuity (5%)								
Asset allocation	A								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-A-a-55-5%]	S[Liv-A-a-60-5%]	S[Liv-A-a-65-5%]	S[Liv-A-b-55-5%]	S[Liv-A-b-60-5%]	S[Liv-A-b-65-5%]	S[Liv-A-c-55-5%]	S[Liv-A-c-60-5%]	S[Liv-A-c-65-5%]
1960-01	R 935 433.90	R 923 422.11	R 821 792.10	R 982 147.69	R 993 038.30	R 971 343.46	R 948 553.05	R 951 693.92	R 898 194.56
1961-01	R 903 676.58	R 899 150.89	R 822 888.09	R 945 555.24	R 962 463.96	R 949 131.77	R 911 719.94	R 921 667.19	R 884 937.74
1962-01	R 887 533.43	R 886 522.58	R 819 691.92	R 919 589.47	R 937 624.34	R 926 809.82	R 893 589.29	R 906 346.16	R 876 956.32
1963-01	R 785 353.17	R 784 539.58	R 720 478.40	R 847 253.16	R 871 745.63	R 880 794.06	R 824 273.58	R 841 779.72	R 841 211.07
1964-01	R 714 500.72	R 715 387.58	R 661 659.49	R 784 581.41	R 809 643.44	R 818 035.50	R 771 355.88	R 793 257.89	R 801 356.33
1965-01	R 704 510.25	R 704 455.75	R 656 958.42	R 776 762.87	R 801 542.91	R 817 681.65	R 759 360.05	R 780 577.70	R 796 878.23
1966-01	R 709 089.79	R 711 842.56	R 671 193.19	R 763 195.73	R 786 932.83	R 810 260.99	R 760 154.61	R 783 406.35	R 807 753.08
1967-01	R 695 109.60	R 700 229.36	R 665 996.86	R 747 848.96	R 773 406.67	R 799 780.75	R 745 082.88	R 770 882.40	R 796 372.71
1968-01	R 632 724.34	R 637 943.12	R 604 895.77	R 684 104.45	R 708 800.71	R 733 804.21	R 701 873.19	R 735 617.62	R 755 053.15
1969-01	R 542 831.56	R 549 326.75	R 519 924.02	R 609 210.36	R 636 849.93	R 657 899.73	R 639 926.85	R 667 452.70	R 684 370.97
1970-01	R 583 608.82	R 584 643.10	R 540 257.36	R 625 053.36	R 641 603.30	R 645 936.24	R 653 470.05	R 674 005.26	R 680 063.94
1971-01	R 723 669.17	R 712 283.63	R 646 779.64	R 733 114.27	R 733 375.53	R 705 034.81	R 763 447.20	R 772 995.69	R 765 793.00
1972-01	R 739 995.76	R 727 055.18	R 664 234.45	R 741 613.10	R 738 594.69	R 705 180.28	R 779 277.57	R 789 008.66	R 797 662.61
1973-01	R 615 563.76	R 610 689.28	R 560 378.10	R 632 809.53	R 639 480.30	R 626 538.24	R 682 469.75	R 704 935.29	R 708 797.36
1974-01	R 633 558.35	R 616 274.15	R 556 657.69	R 647 097.86	R 642 854.48	R 622 152.11	R 688 268.59	R 701 808.85	R 703 950.96
1975-01	R 730 538.15	R 699 373.45	R 624 695.40	R 727 840.07	R 705 769.75	R 656 025.26	R 762 831.91	R 757 241.29	R 753 433.37
1976-01	R 845 480.90	R 798 655.35	R 702 751.89	R 833 029.44	R 791 763.03	R 711 374.76	R 862 706.94	R 840 530.84	R 818 964.94
1977-01	R 994 373.60	R 933 316.73	R 808 040.44	R 970 975.76	R 907 389.08	R 775 527.35	R 989 778.40	R 945 072.19	R 866 654.62
1978-01	R 967 304.52	R 901 029.85	R 776 719.68	R 945 774.47	R 877 465.69	R 749 235.87	R 964 684.59	R 918 538.79	R 849 377.05
1979-01	R 873 611.31	R 808 472.77	R 693 234.98	R 861 433.98	R 801 629.18	R 701 883.60	R 880 442.83	R 850 706.22	R 818 531.54
1980-01	R 801 357.27	R 732 300.95	R 612 679.83	R 791 743.57	R 732 762.29	R 641 482.34	R 795 846.87	R 773 212.12	R 735 886.89
1981-01	R 904 423.22	R 816 930.40	R 674 080.71	R 891 922.74	R 806 667.05	R 672 160.85	R 893 564.94	R 835 685.80	R 771 075.12
1982-01	R 1 093 512.58	R 974 235.69	R 783 812.91	R 1 084 680.44	R 959 627.91	R 758 587.06	R 1 071 004.62	R 976 692.98	R 853 094.23
1983-01	R 946 835.24	R 848 548.27	R 682 877.96	R 931 439.49	R 842 139.92	R 703 224.04	R 919 601.92	R 866 389.84	R 806 430.18
1984-01	R 1 132 307.81	R 1 011 487.43	R 793 791.80	R 1 125 109.27	R 1 000 521.96	R 774 380.61	R 1 097 523.98	R 1 004 366.26	R 870 193.06
1985-01	R 1 413 615.94	R 1 221 103.01	R 929 839.27	R 1 432 994.19	R 1 219 286.59	R 880 551.68	R 1 378 631.73	R 1 205 353.64	R 967 502.39
1986-01	R 1 431 408.89	R 1 248 001.14	R 961 345.96	R 1 440 134.52	R 1 241 177.47	R 919 737.64	R 1 398 637.60	R 1 235 187.65	R 1 004 245.40
1987-01	R 1 322 833.79	R 1 137 799.15	R 864 110.08	R 1 315 584.04	R 1 126 761.00	R 850 373.28	R 1 264 964.21	R 1 112 650.07	R 924 927.05
1988-01	R 1 414 397.85	R 1 232 931.55	R 939 035.45	R 1 425 832.47	R 1 228 747.95	R 898 679.30	R 1 389 001.64	R 1 220 616.27	R 967 077.68
1989-01	R 1 549 957.62	R 1 346 440.06	R 1 016 697.23	R 1 561 853.44	R 1 342 168.63	R 976 589.41	R 1 519 768.74	R 1 331 198.17	R 1 048 920.45

Table A.4E: Present values of switching annuity strategies – asset allocation B to life annuity (5%)

	Switch to life annuity (5%)								
Asset allocation	B								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-B-a-55-5%]	S[Liv-B-a-60-5%]	S[Liv-B-a-65-5%]	S[Liv-B-b-55-5%]	S[Liv-B-b-60-5%]	S[Liv-B-b-65-5%]	S[Liv-B-c-55-5%]	S[Liv-B-c-60-5%]	S[Liv-B-c-65-5%]
1960-01	R 1 095 624.29	R 1 071 548.04	R 929 676.73	R 1 113 526.44	R 1 108 967.14	R 1 037 252.77	R 1 085 040.24	R 1 073 045.98	R 969 388.72
1961-01	R 1 081 422.46	R 1 071 103.79	R 968 759.47	R 1 081 773.06	R 1 087 327.54	R 1 026 902.94	R 1 048 277.73	R 1 046 900.94	R 963 065.15
1962-01	R 1 054 756.55	R 1 049 026.08	R 959 290.87	R 1 047 521.52	R 1 055 337.05	R 1 000 212.88	R 1 021 672.71	R 1 024 215.86	R 951 653.03
1963-01	R 973 577.27	R 964 591.51	R 866 506.42	R 999 874.06	R 1 009 051.32	R 972 535.60	R 979 265.23	R 983 792.65	R 927 416.13
1964-01	R 857 133.12	R 853 048.39	R 776 544.47	R 897 269.99	R 913 036.62	R 898 680.67	R 884 646.46	R 897 775.70	R 875 224.23
1965-01	R 842 760.75	R 836 449.52	R 765 803.89	R 883 294.71	R 897 606.32	R 889 505.45	R 867 653.96	R 878 467.07	R 858 559.35
1966-01	R 811 260.54	R 811 623.51	R 758 928.76	R 840 019.36	R 857 956.79	R 854 164.42	R 837 355.36	R 854 822.66	R 849 768.60
1967-01	R 761 915.31	R 766 183.07	R 725 722.43	R 797 923.46	R 820 492.94	R 831 846.03	R 795 497.44	R 817 845.50	R 832 515.58
1968-01	R 688 195.46	R 691 926.90	R 651 590.10	R 726 800.36	R 747 706.45	R 765 227.70	R 740 924.54	R 773 252.08	R 792 493.92
1969-01	R 549 131.91	R 553 582.55	R 518 947.26	R 615 355.75	R 641 181.92	R 660 240.64	R 645 020.17	R 671 195.45	R 686 507.14
1970-01	R 662 412.92	R 655 883.27	R 587 829.70	R 682 263.21	R 688 260.57	R 669 628.22	R 700 322.80	R 713 878.77	R 704 981.09
1971-01	R 942 737.48	R 911 503.88	R 791 803.62	R 927 726.70	R 903 140.01	R 808 341.05	R 941 498.23	R 925 537.60	R 867 614.51
1972-01	R 956 117.28	R 924 340.77	R 812 743.55	R 935 123.97	R 908 390.12	R 813 078.98	R 959 135.47	R 943 705.65	R 889 901.44
1973-01	R 734 766.48	R 718 953.44	R 637 522.79	R 731 240.20	R 724 152.84	R 675 530.68	R 761 492.32	R 768 641.47	R 757 890.50
1974-01	R 798 937.38	R 764 467.71	R 664 980.92	R 788 272.60	R 764 435.26	R 702 043.64	R 814 888.57	R 805 961.44	R 786 648.12
1975-01	R 901 887.56	R 848 631.19	R 730 174.57	R 879 372.18	R 830 368.62	R 725 660.72	R 902 601.67	R 869 300.25	R 810 788.79
1976-01	R 1 156 087.07	R 1 070 128.72	R 901 489.04	R 1 128 580.37	R 1 038 850.69	R 861 471.32	R 1 142 300.78	R 1 072 079.70	R 950 075.53
1977-01	R 1 440 967.61	R 1 326 674.64	R 1 100 296.81	R 1 420 465.20	R 1 289 194.88	R 1 009 250.64	R 1 424 378.64	R 1 310 937.48	R 1 087 481.19
1978-01	R 1 343 109.54	R 1 235 074.53	R 1 035 188.55	R 1 308 875.54	R 1 186 061.25	R 939 055.78	R 1 325 333.97	R 1 221 712.76	R 1 034 946.71
1979-01	R 1 205 204.95	R 1 102 738.48	R 922 673.03	R 1 181 390.34	R 1 068 807.93	R 864 543.10	R 1 194 062.84	R 1 108 852.22	R 975 873.23
1980-01	R 1 018 734.91	R 919 016.15	R 747 213.42	R 1 004 651.44	R 906 438.97	R 741 389.01	R 995 684.24	R 925 588.07	R 838 205.76
1981-01	R 1 015 530.59	R 911 709.88	R 742 224.61	R 1 000 253.42	R 891 906.12	R 714 140.20	R 1 000 599.91	R 918 781.16	R 807 670.69
1982-01	R 1 270 504.13	R 1 123 589.58	R 888 980.03	R 1 266 769.12	R 1 106 208.39	R 841 420.99	R 1 248 395.53	R 1 118 942.46	R 933 038.76
1983-01	R 1 054 805.23	R 945 587.41	R 760 953.84	R 1 037 422.01	R 931 684.59	R 759 331.40	R 1 032 791.57	R 958 807.43	R 871 166.99
1984-01	R 1 245 855.25	R 1 111 251.53	R 868 464.29	R 1 241 705.51	R 1 097 661.80	R 830 000.60	R 1 214 459.23	R 1 101 757.61	R 925 166.30
1985-01	R 1 619 163.41	R 1 388 870.72	R 1 039 950.45	R 1 658 498.65	R 1 400 315.21	R 979 269.47	R 1 592 083.24	R 1 372 334.63	R 1 056 413.29
1986-01	R 1 499 105.13	R 1 304 190.34	R 999 124.89	R 1 510 701.18	R 1 298 037.34	R 952 468.54	R 1 465 553.52	R 1 288 850.64	R 1 035 274.01
1987-01	R 1 345 858.20	R 1 155 155.20	R 872 635.21	R 1 332 324.42	R 1 140 289.34	R 861 131.53	R 1 277 270.49	R 1 122 787.63	R 935 105.32
1988-01	R 1 434 453.56	R 1 255 463.08	R 964 650.52	R 1 444 988.80	R 1 245 546.02	R 905 587.22	R 1 418 265.26	R 1 246 138.55	R 978 023.29
1989-01	R 1 511 563.01	R 1 323 391.16	R 1 017 357.23	R 1 514 197.44	R 1 309 740.45	R 967 186.23	R 1 487 022.34	R 1 313 000.38	R 1 050 249.25

Table A.4F: Present values of switching annuity strategies – asset allocation C to life annuity (5%)

	Switch to life annuity (5%)								
Asset allocation	C								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-C-a-55-5%]	S[Liv-C-a-60-5%]	S[Liv-C-a-65-5%]	S[Liv-C-b-55-5%]	S[Liv-C-b-60-5%]	S[Liv-C-b-65-5%]	S[Liv-C-c-55-5%]	S[Liv-C-c-60-5%]	S[Liv-C-c-65-5%]
1960-01	R 1 278 552.03	R 1 240 594.48	R 1 052 552.59	R 1 263 797.98	R 1 241 557.78	R 1 113 943.84	R 1 240 848.98	R 1 211 515.01	R 1 050 560.82
1961-01	R 1 285 423.26	R 1 269 249.13	R 1 138 704.18	R 1 234 862.39	R 1 228 039.53	R 1 115 013.91	R 1 201 544.09	R 1 187 811.07	R 1 051 400.87
1962-01	R 1 243 382.53	R 1 232 932.49	R 1 118 640.28	R 1 189 884.68	R 1 186 649.31	R 1 083 739.07	R 1 164 069.58	R 1 155 560.99	R 1 035 187.09
1963-01	R 1 193 666.18	R 1 174 788.31	R 1 035 981.75	R 1 185 897.31	R 1 179 897.57	R 1 080 744.79	R 1 167 589.75	R 1 157 044.83	R 1 038 887.16
1964-01	R 1 014 890.72	R 1 005 334.87	R 903 607.56	R 1 024 743.68	R 1 030 951.46	R 978 475.49	R 1 012 639.95	R 1 016 216.26	R 953 874.78
1965-01	R 994 759.07	R 981 243.10	R 884 351.82	R 1 005 070.48	R 1 007 795.15	R 960 619.28	R 991 194.90	R 990 485.14	R 930 931.12
1966-01	R 912 247.15	R 910 634.06	R 846 839.17	R 915 305.72	R 927 815.32	R 902 264.57	R 912 960.99	R 925 012.79	R 898 098.90
1967-01	R 820 639.88	R 824 634.16	R 779 733.22	R 840 619.71	R 860 953.88	R 861 152.62	R 838 451.93	R 858 575.89	R 859 348.03
1968-01	R 734 520.28	R 737 085.32	R 690 822.79	R 762 266.12	R 780 668.95	R 787 949.75	R 776 116.40	R 804 056.91	R 819 986.34
1969-01	R 548 295.78	R 551 029.51	R 512 512.82	R 614 328.65	R 639 958.40	R 656 433.81	R 643 621.17	R 668 216.34	R 682 345.93
1970-01	R 741 957.07	R 727 206.10	R 633 920.48	R 743 414.75	R 738 428.53	R 692 763.00	R 752 569.78	R 754 549.08	R 727 616.79
1971-01	R 1 217 879.93	R 1 159 705.09	R 967 565.35	R 1 190 509.61	R 1 133 864.44	R 950 101.55	R 1 184 779.21	R 1 135 974.01	R 993 940.07
1972-01	R 1 219 588.48	R 1 162 915.08	R 987 802.22	R 1 183 920.40	R 1 127 159.87	R 951 876.96	R 1 191 536.05	R 1 145 722.77	R 1 016 366.15
1973-01	R 870 427.04	R 841 720.15	R 723 908.34	R 845 372.52	R 822 353.32	R 732 455.78	R 859 842.53	R 846 521.20	R 803 413.34
1974-01	R 998 907.24	R 942 642.35	R 792 982.69	R 956 750.70	R 908 037.20	R 793 707.00	R 964 605.19	R 930 986.54	R 871 758.09
1975-01	R 1 103 988.34	R 1 023 985.40	R 852 656.95	R 1 060 569.20	R 979 461.32	R 809 542.85	R 1 070 433.10	R 1 004 811.47	R 883 257.98
1976-01	R 1 569 672.05	R 1 428 815.65	R 1 158 498.70	R 1 536 141.30	R 1 382 172.97	R 1 070 363.07	R 1 533 326.57	R 1 396 935.63	R 1 145 269.43
1977-01	R 2 066 688.04	R 1 873 052.85	R 1 496 573.20	R 2 068 972.08	R 1 847 882.63	R 1 357 720.62	R 2 073 535.38	R 1 860 733.99	R 1 423 888.14
1978-01	R 1 828 271.95	R 1 664 543.02	R 1 363 881.41	R 1 782 819.50	R 1 587 700.85	R 1 188 193.88	R 1 804 836.45	R 1 625 808.22	R 1 283 315.92
1979-01	R 1 623 596.47	R 1 472 067.91	R 1 206 813.26	R 1 589 978.41	R 1 414 099.86	R 1 076 638.50	R 1 603 847.68	R 1 451 010.41	R 1 184 326.90
1980-01	R 1 279 949.33	R 1 142 046.55	R 905 243.12	R 1 271 140.90	R 1 124 686.66	R 867 863.02	R 1 248 594.60	R 1 130 876.58	R 953 133.72
1981-01	R 1 130 635.95	R 1 010 435.73	R 814 159.05	R 1 110 490.41	R 980 690.01	R 758 454.57	R 1 112 318.82	R 1 006 078.12	R 848 326.21
1982-01	R 1 460 795.76	R 1 284 272.16	R 1 002 288.95	R 1 460 422.37	R 1 265 286.90	R 931 555.24	R 1 441 728.74	R 1 274 385.35	R 1 020 763.90
1983-01	R 1 157 599.94	R 1 039 596.88	R 839 462.26	R 1 134 900.54	R 1 014 656.47	R 812 052.63	R 1 138 671.67	R 1 050 163.62	R 929 378.70
1984-01	R 1 348 719.15	R 1 202 713.39	R 938 984.29	R 1 346 199.87	R 1 185 156.16	R 880 471.54	R 1 320 749.54	R 1 190 885.83	R 976 547.04
1985-01	R 1 817 285.16	R 1 550 504.28	R 1 145 900.84	R 1 880 037.41	R 1 577 467.95	R 1 076 994.39	R 1 803 366.72	R 1 538 293.16	R 1 145 399.33
1986-01	R 1 539 300.50	R 1 338 152.02	R 1 022 991.75	R 1 551 688.99	R 1 331 484.80	R 972 428.70	R 1 504 737.55	R 1 320 804.20	R 1 054 686.16
1987-01	R 1 342 540.80	R 1 151 294.74	R 867 670.28	R 1 320 938.78	R 1 131 808.44	R 859 996.38	R 1 262 756.80	R 1 112 103.55	R 934 184.29
1988-01	R 1 424 227.02	R 1 253 386.32	R 974 922.14	R 1 426 947.00	R 1 233 077.29	R 896 204.23	R 1 411 861.34	R 1 242 853.80	R 972 987.02
1989-01	R 1 442 647.76	R 1 274 911.52	R 1 001 003.48	R 1 433 458.21	R 1 250 672.01	R 943 278.92	R 1 421 819.72	R 1 268 740.50	R 1 037 454.02

Appendix B

Equity fund calculations

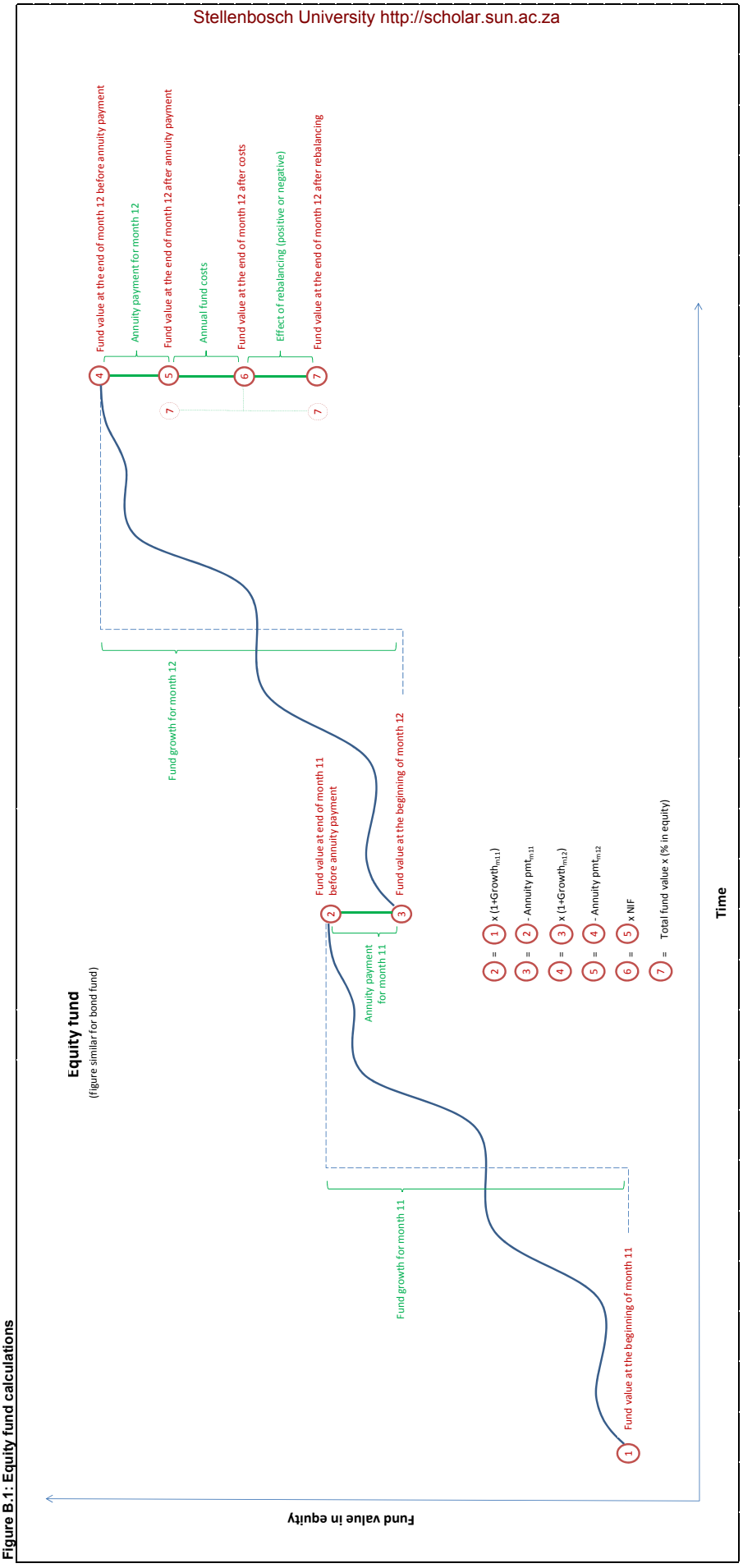

Figure B.1: Equity fund calculations

Appendix C

Life annuity rates

Table C.1: Life annuity rates

	LEVEL ANNUITY			ANNUITY INCREASING AT 5%		
	Age = 55	Age = 60	Age = 65	Age = 55	Age = 60	Age = 65
Date	Male	Male	Male	Male	Male	Male
1960-01	61.62	67.01	73.74	35.95	41.68	49.29
1960-02	61.62	67.01	73.74	35.95	41.68	49.29
1960-03	61.62	67.01	73.74	35.95	41.68	49.29
1960-04	61.62	67.01	73.74	35.95	41.68	49.29
1960-05	61.62	67.01	73.74	35.95	41.68	49.29
1960-06	61.62	67.01	73.74	35.95	41.68	49.29
1960-07	61.62	67.01	73.74	35.95	41.68	49.29
1960-08	61.62	67.01	73.74	35.95	41.68	49.29
1960-09	62.32	67.67	74.34	36.51	42.21	49.80
1960-10	62.32	67.67	74.34	36.51	42.21	49.80
1960-11	62.32	67.67	74.34	36.51	42.21	49.80
1960-12	62.32	67.67	74.34	36.51	42.21	49.80
1961-01	62.32	67.67	74.34	36.51	42.21	49.80
1961-02	63.68	68.93	75.51	37.59	43.24	50.78
1961-03	63.68	68.93	75.51	37.59	43.24	50.78
1961-04	63.68	68.93	75.51	37.59	43.24	50.78
1961-05	65.05	70.21	76.68	38.69	44.29	51.77
1961-06	65.05	70.21	76.68	38.69	44.29	51.77
1961-07	65.05	70.21	76.68	38.69	44.29	51.77
1961-08	65.05	70.21	76.68	38.69	44.29	51.77
1961-09	65.05	70.21	76.68	38.69	44.29	51.77
1961-10	65.05	70.21	76.68	38.69	44.29	51.77
1961-11	65.05	70.21	76.68	38.69	44.29	51.77
1961-12	65.05	70.21	76.68	38.69	44.29	51.77
1962-01	65.05	70.21	76.68	38.69	44.29	51.77
1962-02	65.05	70.21	76.68	38.69	44.29	51.77
1962-03	65.05	70.21	76.68	38.69	44.29	51.77
1962-04	65.05	70.21	76.68	38.69	44.29	51.77
1962-05	64.34	69.54	76.07	38.12	43.74	51.26
1962-06	63.68	68.93	75.51	37.59	43.24	50.78
1962-07	61.62	67.01	73.74	35.95	41.68	49.29
1962-08	60.27	65.76	72.58	34.89	40.66	48.32
1962-09	60.27	65.76	72.58	34.89	40.66	48.32
1962-10	60.27	65.76	72.58	34.89	40.66	48.32
1962-11	58.94	64.51	71.43	33.85	39.65	47.36
1962-12	58.94	64.51	71.43	33.85	39.65	47.36
1963-01	58.94	64.51	71.43	33.85	39.65	47.36
1963-02	58.94	64.51	71.43	33.85	39.65	47.36
1963-03	58.94	64.51	71.43	33.85	39.65	47.36
1963-04	58.94	64.51	71.43	33.85	39.65	47.36
1963-05	58.94	64.51	71.43	33.85	39.65	47.36
1963-06	58.94	64.51	71.43	33.85	39.65	47.36
1963-07	58.94	64.51	71.43	33.85	39.65	47.36
1963-08	58.94	64.51	71.43	33.85	39.65	47.36
1963-09	58.94	64.51	71.43	33.85	39.65	47.36
1963-10	58.94	64.51	71.43	33.85	39.65	47.36
1963-11	58.94	64.51	71.43	33.85	39.65	47.36
1963-12	58.94	64.51	71.43	33.85	39.65	47.36
1964-01	58.94	64.51	71.43	33.85	39.65	47.36
1964-02	58.94	64.51	71.43	33.85	39.65	47.36
1964-03	58.94	64.51	71.43	33.85	39.65	47.36
1964-04	58.94	64.51	71.43	33.85	39.65	47.36
1964-05	58.94	64.51	71.43	33.85	39.65	47.36
1964-06	58.94	64.51	71.43	33.85	39.65	47.36
1964-07	58.94	64.51	71.43	33.85	39.65	47.36
1964-08	58.94	64.51	71.43	33.85	39.65	47.36
1964-09	58.94	64.51	71.43	33.85	39.65	47.36
1964-10	58.94	64.51	71.43	33.85	39.65	47.36
1964-11	58.94	64.51	71.43	33.85	39.65	47.36
1964-12	60.27	65.76	72.58	34.89	40.66	48.32
1965-01	60.27	65.76	72.58	34.89	40.66	48.32

Table C.1: Life annuity rates

	LEVEL ANNUITY			ANNUITY INCREASING AT 5%		
	Age = 55	Age = 60	Age = 65	Age = 55	Age = 60	Age = 65
Date	Male	Male	Male	Male	Male	Male
1965-02	60.27	65.76	72.58	34.89	40.66	48.32
1965-03	61.62	67.01	73.74	35.95	41.68	49.29
1965-04	62.97	68.28	74.90	37.03	42.70	50.27
1965-05	62.97	68.28	74.90	37.03	42.70	50.27
1965-06	62.97	68.28	74.90	37.03	42.70	50.27
1965-07	62.97	68.28	74.90	37.03	42.70	50.27
1965-08	65.70	70.82	77.24	39.22	44.79	52.25
1965-09	65.70	70.82	77.24	39.22	44.79	52.25
1965-10	65.70	70.82	77.24	39.22	44.79	52.25
1965-11	65.70	70.82	77.24	39.22	44.79	52.25
1965-12	65.70	70.82	77.24	39.22	44.79	52.25
1966-01	65.70	70.82	77.24	39.22	44.79	52.25
1966-02	65.70	70.82	77.24	39.22	44.79	52.25
1966-03	65.70	70.82	77.24	39.22	44.79	52.25
1966-04	65.70	70.82	77.24	39.22	44.79	52.25
1966-05	65.70	70.82	77.24	39.22	44.79	52.25
1966-06	65.70	70.82	77.24	39.22	44.79	52.25
1966-07	68.46	73.38	79.60	41.47	46.92	54.26
1966-08	68.46	73.38	79.60	41.47	46.92	54.26
1966-09	68.46	73.38	79.60	41.47	46.92	54.26
1966-10	68.46	73.38	79.60	41.47	46.92	54.26
1966-11	68.46	73.38	79.60	41.47	46.92	54.26
1966-12	68.46	73.38	79.60	41.47	46.92	54.26
1967-01	68.46	73.38	79.60	41.47	46.92	54.26
1967-02	68.46	73.38	79.60	41.47	46.92	54.26
1967-03	68.46	73.38	79.60	41.47	46.92	54.26
1967-04	68.46	73.38	79.60	41.47	46.92	54.26
1967-05	68.46	73.38	79.60	41.47	46.92	54.26
1967-06	68.46	73.38	79.60	41.47	46.92	54.26
1967-07	68.46	73.38	79.60	41.47	46.92	54.26
1967-08	68.46	73.38	79.60	41.47	46.92	54.26
1967-09	68.46	73.38	79.60	41.47	46.92	54.26
1967-10	68.46	73.38	79.60	41.47	46.92	54.26
1967-11	68.46	73.38	79.60	41.47	46.92	54.26
1967-12	68.46	73.38	79.60	41.47	46.92	54.26
1968-01	68.46	73.38	79.60	41.47	46.92	54.26
1968-02	68.46	73.38	79.60	41.47	46.92	54.26
1968-03	68.46	73.38	79.60	41.47	46.92	54.26
1968-04	68.46	73.38	79.60	41.47	46.92	54.26
1968-05	68.46	73.38	79.60	41.47	46.92	54.26
1968-06	68.46	73.38	79.60	41.47	46.92	54.26
1968-07	68.46	73.38	79.60	41.47	46.92	54.26
1968-08	68.46	73.38	79.60	41.47	46.92	54.26
1968-09	68.46	73.38	79.60	41.47	46.92	54.26
1968-10	68.46	73.38	79.60	41.47	46.92	54.26
1968-11	68.46	73.38	79.60	41.47	46.92	54.26
1968-12	68.46	73.38	79.60	41.47	46.92	54.26
1969-01	68.46	73.38	79.60	41.47	46.92	54.26
1969-02	68.46	73.38	79.60	41.47	46.92	54.26
1969-03	68.46	73.38	79.60	41.47	46.92	54.26
1969-04	68.46	73.38	79.60	41.47	46.92	54.26
1969-05	68.46	73.38	79.60	41.47	46.92	54.26
1969-06	68.46	73.38	79.60	41.47	46.92	54.26
1969-07	68.46	73.38	79.60	41.47	46.92	54.26
1969-08	68.46	73.38	79.60	41.47	46.92	54.26
1969-09	68.46	73.38	79.60	41.47	46.92	54.26
1969-10	68.46	73.38	79.60	41.47	46.92	54.26
1969-11	68.46	73.38	79.60	41.47	46.92	54.26
1969-12	68.46	73.38	79.60	41.47	46.92	54.26
1970-01	68.46	73.38	79.60	41.47	46.92	54.26
1970-02	68.46	73.38	79.60	41.47	46.92	54.26

Table C.1: Life annuity rates

	LEVEL ANNUITY			ANNUITY INCREASING AT 5%		
	Age = 55	Age = 60	Age = 65	Age = 55	Age = 60	Age = 65
Date	Male	Male	Male	Male	Male	Male
1970-03	68.46	73.38	79.60	41.47	46.92	54.26
1970-04	68.46	73.38	79.60	41.47	46.92	54.26
1970-05	71.25	75.97	81.97	43.77	49.09	56.29
1970-06	71.25	75.97	81.97	43.77	49.09	56.29
1970-07	71.25	75.97	81.97	43.77	49.09	56.29
1970-08	75.48	79.89	85.56	47.31	52.40	59.39
1970-09	75.48	79.89	85.56	47.31	52.40	59.39
1970-10	75.48	79.89	85.56	47.31	52.40	59.39
1970-11	75.48	79.89	85.56	47.31	52.40	59.39
1970-12	75.48	79.89	85.56	47.31	52.40	59.39
1971-01	75.48	79.89	85.56	47.31	52.40	59.39
1971-02	75.48	79.89	85.56	47.31	52.40	59.39
1971-03	79.75	83.85	89.19	50.95	55.80	62.55
1971-04	79.75	83.85	89.19	50.95	55.80	62.55
1971-05	79.75	83.85	89.19	50.95	55.80	62.55
1971-06	79.75	83.85	89.19	50.95	55.80	62.55
1971-07	79.75	83.85	89.19	50.95	55.80	62.55
1971-08	79.75	83.85	89.19	50.95	55.80	62.55
1971-09	79.75	83.85	89.19	50.95	55.80	62.55
1971-10	79.75	83.85	89.19	50.95	55.80	62.55
1971-11	79.75	83.85	89.19	50.95	55.80	62.55
1971-12	79.75	83.85	89.19	50.95	55.80	62.55
1972-01	79.75	83.85	89.19	50.95	55.80	62.55
1972-02	79.75	83.85	89.19	50.95	55.80	62.55
1972-03	79.75	83.85	89.19	50.95	55.80	62.55
1972-04	79.75	83.85	89.19	50.95	55.80	62.55
1972-05	79.75	83.85	89.19	50.95	55.80	62.55
1972-06	79.75	83.85	89.19	50.95	55.80	62.55
1972-07	79.75	83.85	89.19	50.95	55.80	62.55
1972-08	78.32	82.52	87.98	49.72	54.66	61.49
1972-09	77.63	81.89	87.40	49.14	54.11	60.98
1972-10	77.63	81.89	87.40	49.14	54.11	60.98
1972-11	77.63	81.89	87.40	49.14	54.11	60.98
1972-12	77.63	81.89	87.40	49.14	54.11	60.98
1973-01	77.63	81.89	87.40	49.14	54.11	60.98
1973-02	77.63	81.89	87.40	49.14	54.11	60.98
1973-03	75.48	79.89	85.56	47.31	52.40	59.39
1973-04	75.48	79.89	85.56	47.31	52.40	59.39
1973-05	75.48	79.89	85.56	47.31	52.40	59.39
1973-06	75.48	79.89	85.56	47.31	52.40	59.39
1973-07	75.48	79.89	85.56	47.31	52.40	59.39
1973-08	75.48	79.89	85.56	47.31	52.40	59.39
1973-09	75.48	79.89	85.56	47.31	52.40	59.39
1973-10	75.48	79.89	85.56	47.31	52.40	59.39
1973-11	75.48	79.89	85.56	47.31	52.40	59.39
1973-12	76.89	81.20	86.77	48.51	53.53	60.44
1974-01	78.32	82.52	87.98	49.72	54.66	61.49
1974-02	78.32	82.52	87.98	49.72	54.66	61.49
1974-03	78.32	82.52	87.98	49.72	54.66	61.49
1974-04	78.32	82.52	87.98	49.72	54.66	61.49
1974-05	78.32	82.52	87.98	49.72	54.66	61.49
1974-06	79.75	83.85	89.19	50.95	55.80	62.55
1974-07	84.06	87.84	92.84	54.68	59.26	65.76
1974-08	86.96	90.52	95.30	57.22	61.61	67.92
1974-09	86.96	90.52	95.30	57.22	61.61	67.92
1974-10	86.96	90.52	95.30	57.22	61.61	67.92
1974-11	86.96	90.52	95.30	57.22	61.61	67.92
1974-12	85.51	89.18	94.07	55.95	60.43	66.84
1975-01	85.51	89.18	94.07	55.95	60.43	66.84
1975-02	85.51	89.18	94.07	55.95	60.43	66.84
1975-03	85.51	89.18	94.07	55.95	60.43	66.84

Table C.1: Life annuity rates

	LEVEL ANNUITY			ANNUITY INCREASING AT 5%		
	Age = 55	Age = 60	Age = 65	Age = 55	Age = 60	Age = 65
Date	Male	Male	Male	Male	Male	Male
1975-04	85.51	89.18	94.07	55.95	60.43	66.84
1975-05	85.51	89.18	94.07	55.95	60.43	66.84
1975-06	85.51	89.18	94.07	55.95	60.43	66.84
1975-07	85.51	89.18	94.07	55.95	60.43	66.84
1975-08	88.41	91.87	96.53	58.51	62.79	69.01
1975-09	88.41	91.87	96.53	58.51	62.79	69.01
1975-10	88.41	91.87	96.53	58.51	62.79	69.01
1975-11	88.41	91.87	96.53	58.51	62.79	69.01
1975-12	88.41	91.87	96.53	58.51	62.79	69.01
1976-01	89.40	92.79	97.36	59.38	63.60	69.76
1976-02	88.53	91.98	96.62	58.61	62.89	69.10
1976-03	87.94	91.44	96.13	58.09	62.41	68.67
1976-04	88.35	91.82	96.48	58.45	62.75	68.97
1976-05	88.47	91.92	96.58	58.56	62.84	69.06
1976-06	88.64	92.08	96.72	58.71	62.98	69.19
1976-07	88.53	91.98	96.62	58.61	62.89	69.10
1976-08	91.33	94.57	99.00	61.10	65.18	71.21
1976-09	95.66	98.59	102.67	64.99	68.76	74.50
1976-10	95.60	98.53	102.62	64.93	68.71	74.46
1976-11	94.84	97.83	101.97	64.25	68.08	73.88
1976-12	94.25	97.28	101.48	63.72	67.60	73.43
1977-01	95.25	98.21	102.32	64.62	68.42	74.19
1977-02	94.90	97.88	102.02	64.30	68.13	73.92
1977-03	94.72	97.72	101.87	64.14	67.98	73.79
1977-04	95.78	98.70	102.77	65.09	68.86	74.59
1977-05	94.55	97.55	101.73	63.98	67.84	73.65
1977-06	94.84	97.83	101.97	64.25	68.08	73.88
1977-07	94.43	97.45	101.63	63.88	67.74	73.56
1977-08	94.90	97.88	102.02	64.30	68.13	73.92
1977-09	93.67	96.74	100.98	63.19	67.11	72.99
1977-10	93.67	96.74	100.98	63.19	67.11	72.99
1977-11	92.50	95.65	99.99	62.14	66.14	72.10
1977-12	92.44	95.60	99.94	62.09	66.10	72.05
1978-01	93.55	96.63	100.88	63.09	67.01	72.90
1978-02	93.08	96.20	100.48	62.67	66.63	72.54
1978-03	92.79	95.92	100.23	62.40	66.39	72.32
1978-04	92.32	95.49	99.84	61.98	66.00	71.96
1978-05	91.79	95.00	99.39	61.51	65.57	71.57
1978-06	91.73	94.95	99.34	61.46	65.52	71.52
1978-07	91.73	94.95	99.34	61.46	65.52	71.52
1978-08	90.39	93.70	98.20	60.26	64.42	70.51
1978-09	89.57	92.95	97.51	59.54	63.75	69.89
1978-10	87.77	91.28	95.98	57.94	62.27	68.53
1978-11	87.13	90.68	95.44	57.38	61.75	68.05
1978-12	86.78	90.36	95.15	57.07	61.47	67.79
1979-01	84.58	88.32	93.28	55.14	59.68	66.15
1979-02	83.02	86.88	91.96	53.78	58.43	64.98
1979-03	83.25	87.09	92.16	53.98	58.61	65.15
1979-04	83.20	87.04	92.11	53.93	58.56	65.11
1979-05	84.64	88.38	93.33	55.19	59.73	66.19
1979-06	84.64	88.38	93.33	55.19	59.73	66.19
1979-07	85.45	89.13	94.02	55.90	60.39	66.79
1979-08	84.52	88.27	93.23	55.09	59.64	66.10
1979-09	83.60	87.41	92.45	54.28	58.89	65.41
1979-10	83.48	87.31	92.35	54.18	58.80	65.33
1979-11	84.58	88.32	93.28	55.14	59.68	66.15
1979-12	84.47	88.22	93.19	55.04	59.59	66.06
1980-01	84.00	87.79	92.79	54.63	59.22	65.71
1980-02	84.12	87.90	92.89	54.73	59.31	65.80
1980-03	84.12	87.90	92.89	54.73	59.31	65.80
1980-04	84.99	88.70	93.63	55.49	60.01	66.45

Table C.1: Life annuity rates

	LEVEL ANNUITY			ANNUITY INCREASING AT 5%		
	Age = 55	Age = 60	Age = 65	Age = 55	Age = 60	Age = 65
Date	Male	Male	Male	Male	Male	Male
1980-05	85.68	89.34	94.21	56.10	60.57	66.97
1980-06	85.74	89.40	94.26	56.15	60.62	67.01
1980-07	87.54	91.06	95.79	57.73	62.08	68.36
1980-08	88.88	92.30	96.92	58.92	63.17	69.37
1980-09	90.74	94.03	98.50	60.57	64.70	70.77
1980-10	94.90	97.88	102.02	64.30	68.13	73.92
1980-11	97.43	100.22	104.17	66.58	70.23	75.85
1980-12	99.02	101.70	105.52	68.03	71.55	77.06
1981-01	102.97	105.37	108.87	71.65	74.87	80.10
1981-02	104.45	106.74	110.13	73.01	76.12	81.24
1981-03	104.57	106.85	110.23	73.12	76.22	81.33
1981-04	104.22	106.52	109.93	72.79	75.92	81.06
1981-05	106.35	108.50	111.74	74.76	77.72	82.71
1981-06	106.23	108.39	111.64	74.65	77.62	82.61
1981-07	106.17	108.33	111.59	74.59	77.57	82.57
1981-08	106.65	108.78	112.00	75.03	77.97	82.94
1981-09	107.36	109.44	112.60	75.69	78.58	83.49
1981-10	107.30	109.38	112.55	75.64	78.53	83.44
1981-11	107.48	109.55	112.70	75.80	78.68	83.58
1981-12	108.01	110.04	113.16	76.30	79.13	83.99
1982-01	111.58	113.35	116.19	79.61	82.17	86.77
1982-02	113.18	114.85	117.56	81.12	83.54	88.02
1982-03	113.78	115.40	118.07	81.67	84.05	88.49
1982-04	113.30	114.96	117.66	81.23	83.65	88.12
1982-05	112.88	114.57	117.31	80.84	83.29	87.79
1982-06	114.91	116.45	119.03	82.74	85.02	89.38
1982-07	116.16	117.61	120.10	83.91	86.10	90.36
1982-08	112.53	114.24	117.00	80.50	82.98	87.51
1982-09	104.40	106.69	110.08	72.95	76.07	81.19
1982-10	101.26	103.78	107.42	70.08	73.43	78.78
1982-11	98.96	101.64	105.47	67.98	71.51	77.02
1982-12	96.07	98.97	103.02	65.36	69.10	74.81
1983-01	91.79	95.00	99.39	61.51	65.57	71.57
1983-02	96.60	99.46	103.47	65.84	69.54	75.22
1983-03	101.61	104.11	107.72	70.40	73.73	79.05
1983-04	100.08	102.68	106.42	69.00	72.44	77.87
1983-05	101.61	104.11	107.72	70.40	73.73	79.05
1983-06	106.77	108.89	112.10	75.14	78.07	83.03
1983-07	107.77	109.82	112.95	76.08	78.93	83.81
1983-08	108.43	110.43	113.51	76.68	79.48	84.32
1983-09	106.88	109.00	112.20	75.25	78.17	83.12
1983-10	107.77	109.82	112.95	76.08	78.93	83.81
1983-11	109.79	111.70	114.67	77.95	80.65	85.38
1983-12	109.85	111.75	114.72	78.01	80.70	85.43
1984-01	112.77	114.46	117.20	80.73	83.19	87.70
1984-02	110.80	112.64	115.53	78.89	81.51	86.17
1984-03	110.68	112.52	115.43	78.78	81.41	86.07
1984-04	114.73	116.28	118.88	82.57	84.87	89.24
1984-05	117.11	118.50	120.91	84.81	86.92	91.11
1984-06	116.28	117.72	120.20	84.02	86.20	90.45
1984-07	120.51	121.66	123.82	88.02	89.86	93.79
1984-08	123.90	124.83	126.72	91.25	92.81	96.49
1984-09	127.48	128.16	129.79	94.66	95.94	99.34
1984-10	126.71	127.44	129.13	93.92	95.26	98.72
1984-11	125.16	126.00	127.80	92.44	93.91	97.48
1984-12	125.45	126.27	128.05	92.72	94.17	97.72
1985-01	129.15	129.72	131.23	96.26	97.40	100.68
1985-02	132.37	132.73	133.99	99.35	100.23	103.26
1985-03	131.65	132.06	133.38	98.66	99.60	102.69
1985-04	127.24	127.94	129.59	94.43	95.73	99.15
1985-05	125.39	126.22	128.00	92.67	94.11	97.67

Table C.1: Life annuity rates

	LEVEL ANNUITY			ANNUITY INCREASING AT 5%		
	Age = 55	Age = 60	Age = 65	Age = 55	Age = 60	Age = 65
Date	Male	Male	Male	Male	Male	Male
1985-06	120.80	121.94	124.07	88.30	90.12	94.03
1985-07	119.97	121.16	123.36	87.51	89.39	93.37
1985-08	124.80	125.66	127.49	92.10	93.59	97.20
1985-09	128.38	129.00	130.56	95.52	96.72	100.05
1985-10	131.89	132.28	133.58	98.89	99.81	102.88
1985-11	135.47	135.62	136.66	102.33	102.97	105.76
1985-12	136.36	136.46	137.43	103.20	103.76	106.48
1986-01	133.56	133.84	135.02	100.50	101.29	104.22
1986-02	130.94	131.39	132.76	97.97	98.97	102.11
1986-03	131.59	132.00	133.33	98.60	99.55	102.64
1986-04	132.01	132.39	133.69	99.00	99.92	102.97
1986-05	130.52	131.00	132.41	97.57	98.61	101.78
1986-06	132.13	132.51	133.79	99.12	100.02	103.07
1986-07	126.29	127.05	128.77	93.52	94.89	98.39
1986-08	117.29	118.67	121.06	84.98	87.08	91.25
1986-09	114.97	116.51	119.08	82.79	85.08	89.42
1986-10	122.47	123.49	125.50	89.88	91.57	95.35
1986-11	121.76	122.83	124.89	89.21	90.95	94.78
1986-12	119.49	120.72	122.95	87.06	88.98	92.99
1987-01	118.78	120.05	122.34	86.38	88.36	92.42
1987-02	120.21	121.38	123.56	87.74	89.60	93.55
1987-03	117.71	119.05	121.42	85.37	87.44	91.58
1987-04	119.02	120.27	122.54	86.61	88.57	92.61
1987-05	121.22	122.33	124.43	88.70	90.48	94.36
1987-06	121.52	122.61	124.68	88.98	90.74	94.59
1987-07	120.92	122.05	124.17	88.41	90.22	94.12
1987-08	118.48	119.78	122.08	86.10	88.10	92.19
1987-09	118.84	120.11	122.39	86.44	88.41	92.47
1987-10	119.37	120.61	122.85	86.95	88.88	92.89
1987-11	119.79	121.00	123.20	87.34	89.24	93.22
1987-12	120.69	121.83	123.97	88.19	90.01	93.93
1988-01	124.74	125.61	127.44	92.04	93.54	97.15
1988-02	127.06	127.77	129.43	94.26	95.57	99.01
1988-03	127.60	128.28	129.90	94.77	96.04	99.43
1988-04	126.59	127.33	129.03	93.80	95.16	98.62
1988-05	126.53	127.27	128.97	93.75	95.10	98.58
1988-06	124.68	125.55	127.39	91.98	93.49	97.10
1988-07	124.44	125.33	127.18	91.76	93.28	96.91
1988-08	124.38	125.27	127.13	91.70	93.23	96.87
1988-09	124.08	124.99	126.88	91.42	92.97	96.63
1988-10	126.71	127.44	129.13	93.92	95.26	98.72
1988-11	128.49	129.11	130.66	95.63	96.83	100.15
1988-12	128.14	128.78	130.36	95.29	96.51	99.86
1989-01	127.72	128.39	130.00	94.89	96.15	99.53
1989-02	127.72	128.39	130.00	94.89	96.15	99.53
1989-03	129.39	129.94	131.43	96.49	97.61	100.87
1989-04	131.18	131.61	132.97	98.20	99.18	102.30
1989-05	132.13	132.51	133.79	99.12	100.02	103.07
1989-06	131.30	131.73	133.07	98.32	99.29	102.40
1989-07	131.00	131.45	132.82	98.03	99.03	102.16
1989-08	130.10	130.61	132.05	97.17	98.24	101.44
1989-09	128.85	129.44	130.97	95.97	97.14	100.44
1989-10	129.51	130.06	131.53	96.60	97.72	100.96
1989-11	129.39	129.94	131.43	96.49	97.61	100.87
1989-12	123.01	123.99	125.96	90.39	92.03	95.77

Appendix D

Present values of composite annuity strategies minus pure living annuity strategies

Table D.1A: Present values of composite annuity strategies minus pure living annuity strategies – asset allocation A with life annuity (0%)

	Composite with life annuity (0%)								
Asset allocation	A								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-A-a-55-0%]	C[Liv-A-a-60-0%]	C[Liv-A-a-65-0%]	C[Liv-A-b-55-0%]	C[Liv-A-b-60-0%]	C[Liv-A-b-65-0%]	C[Liv-A-c-55-0%]	C[Liv-A-c-60-0%]	C[Liv-A-c-65-0%]
1960-01	R -38 338.92	R -52 271.54	R 41 220.12	R 18 030.52	R 18 158.89	R 73 875.72	R 45 612.43	R 30 657.80	R 76 880.85
1961-01	R -17 696.25	R 2 370.02	R 39 379.26	R 36 247.26	R 46 379.03	R 85 108.89	R 62 803.59	R 62 918.06	R 79 947.57
1962-01	R 16 970.14	R 23 957.45	R 33 051.78	R 36 619.26	R 47 287.38	R 79 109.38	R 76 241.07	R 74 932.65	R 77 170.64
1963-01	R -18 653.44	R -23 435.16	R -20 955.03	R 28 203.74	R 25 788.67	R 44 597.96	R 115 614.63	R 96 790.89	R 83 653.21
1964-01	R -37 164.24	R -41 304.35	R -26 086.36	R 15 982.33	R 13 311.65	R 32 015.67	R 134 674.73	R 113 224.31	R 99 915.37
1965-01	R -40 472.00	R -22 469.07	R -14 562.03	R 5 858.43	R 8 349.03	R 27 347.85	R 119 173.60	R 104 589.95	R 91 416.44
1966-01	R -12 554.91	R -24 706.14	R 19 635.23	R 7 432.63	R 5 377.24	R 40 275.70	R 119 448.45	R 103 110.58	R 105 974.04
1967-01	R -31 646.99	R -41 927.55	R -6 177.13	R -5 428.96	R -6 794.88	R 21 848.72	R 105 366.19	R 90 182.77	R 88 988.85
1968-01	R -25 750.89	R -39 179.93	R -22 262.91	R -7 067.63	R -9 491.84	R 9 583.61	R 132 426.57	R 115 778.36	R 103 509.69
1969-01	R -39 931.46	R -49 432.72	R -26 860.12	R -26 544.77	R -29 615.44	R -9 059.56	R 147 116.01	R 130 812.69	R 117 610.52
1970-01	R -23 253.31	R -39 562.88	R -24 281.60	R -12 783.01	R -17 728.56	R -3 411.19	R 143 880.21	R 127 370.79	R 112 498.13
1971-01	R 26 717.73	R 15 761.34	R 14 545.39	R 27 395.69	R 19 713.78	R 28 983.10	R 146 340.50	R 135 472.61	R 120 348.80
1972-01	R 53 170.94	R 45 768.24	R 34 447.77	R 49 915.96	R 42 246.46	R 39 567.38	R 147 448.02	R 140 316.04	R 125 431.49
1973-01	R 40 013.86	R 959.84	R 16 040.68	R 30 092.31	R 2 673.58	R 17 327.41	R 152 619.31	R 138 449.11	R 127 294.73
1974-01	R 35 572.97	R 13 886.05	R 7 804.57	R 30 897.38	R 14 081.73	R 16 822.24	R 167 015.35	R 155 202.43	R 138 810.88
1975-01	R 94 892.27	R 47 742.12	R 36 900.38	R 94 973.42	R 45 248.07	R 37 637.12	R 137 310.22	R 127 946.70	R 118 647.60
1976-01	R 133 177.08	R 119 640.20	R 95 469.81	R 139 705.57	R 121 193.26	R 92 861.39	R 149 383.58	R 151 040.50	R 146 611.26
1977-01	R 211 307.85	R 146 185.46	R 129 788.11	R 239 266.58	R 148 885.85	R 125 889.38	R 170 630.41	R 149 294.40	R 148 241.83
1978-01	R 185 359.52	R 188 452.17	R 128 208.81	R 199 797.51	R 205 192.57	R 125 247.17	R 165 449.10	R 174 420.41	R 157 151.08
1979-01	R 236 738.38	R 168 029.89	R 133 239.03	R 256 766.50	R 169 498.19	R 130 353.34	R 219 282.82	R 208 436.07	R 198 748.52
1980-01	R 185 775.18	R 122 594.21	R 98 079.17	R 189 942.50	R 115 851.79	R 87 666.60	R 176 860.46	R 169 853.13	R 165 315.39
1981-01	R 185 448.66	R 82 666.03	R 58 926.12	R 222 647.88	R 87 169.89	R 57 158.44	R 101 106.59	R 79 121.96	R 85 675.00
1982-01	R 241 032.07	R 190 799.26	R 151 137.88	R 299 053.49	R 228 532.80	R 162 274.75	R 183 218.01	R 138 895.89	R 125 757.49
1983-01	R 282 107.25	R 209 749.43	R 130 218.53	R 299 320.14	R 207 173.24	R 120 446.24	R 173 369.88	R 167 547.69	R 159 873.05
1984-01	R 346 770.67	R 243 320.17	R 166 856.86	R 438 256.54	R 287 375.61	R 176 133.58	R 256 206.64	R 172 628.99	R 137 251.44
1985-01	R 460 972.08	R 274 336.88	R 169 016.22	R 636 172.13	R 347 618.65	R 184 606.99	R 445 767.62	R 252 901.81	R 160 570.42
1986-01	R 471 694.69	R 316 601.46	R 233 153.95	R 636 423.57	R 402 379.31	R 266 570.40	R 449 865.93	R 283 974.56	R 204 735.48
1987-01	R 339 328.20	R 282 216.17	R 186 290.04	R 406 935.24	R 325 575.14	R 192 522.88	R 262 834.09	R 195 684.40	R 129 975.57
1988-01	R 344 422.25	R 376 365.10	R 230 138.43	R 445 749.86	R 497 489.18	R 268 855.11	R 352 915.22	R 368 859.45	R 212 144.90
1989-01	R 390 702.26	R 442 632.31	R 262 604.12	R 485 252.37	R 557 788.67	R 293 368.92	R 395 319.74	R 430 552.76	R 243 899.78

Table D.1B: Present values of composite annuity strategies minus pure living annuity strategies – asset allocation B with life annuity (0%)

	Composite with life annuity (0%)								
Asset allocation	B								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-B-a-55-0%]	C[Liv-B-a-60-0%]	C[Liv-B-a-65-0%]	C[Liv-B-b-55-0%]	C[Liv-B-b-60-0%]	C[Liv-B-b-65-0%]	C[Liv-B-c-55-0%]	C[Liv-B-c-60-0%]	C[Liv-B-c-65-0%]
1960-01	R 121 956.49	R 47 174.44	R 160 437.55	R 116 614.09	R 97 300.59	R 159 634.36	R 111 591.55	R 77 639.98	R 148 928.04
1961-01	R 184 356.69	R 157 871.27	R 186 284.97	R 177 436.68	R 164 237.93	R 201 222.39	R 175 713.32	R 152 866.63	R 191 945.17
1962-01	R 240 883.91	R 209 661.35	R 160 653.42	R 210 681.77	R 183 196.98	R 180 760.12	R 208 569.16	R 181 991.59	R 169 205.23
1963-01	R 161 860.37	R 137 104.31	R 76 092.78	R 144 217.33	R 134 907.15	R 130 114.43	R 167 728.74	R 159 846.67	R 126 565.92
1964-01	R 109 000.35	R 92 109.55	R 58 440.73	R 109 095.03	R 99 288.39	R 104 919.59	R 170 115.81	R 156 922.44	R 133 431.60
1965-01	R 110 451.63	R 121 835.74	R 70 182.59	R 96 759.90	R 93 947.79	R 94 120.00	R 152 892.02	R 150 392.08	R 129 324.93
1966-01	R 160 599.65	R 107 633.05	R 127 520.47	R 124 450.57	R 88 941.64	R 114 096.40	R 162 738.18	R 143 137.52	R 157 591.68
1967-01	R 97 165.98	R 69 842.59	R 90 496.25	R 84 382.22	R 63 501.81	R 84 820.33	R 137 657.82	R 122 789.33	R 133 731.83
1968-01	R 99 280.73	R 70 691.54	R 59 993.60	R 77 909.86	R 55 389.90	R 59 525.29	R 157 984.62	R 144 786.09	R 136 701.63
1969-01	R 53 065.22	R 31 809.39	R 26 202.42	R 10 601.30	R 168.81	R 10 390.45	R 163 344.14	R 149 962.18	R 137 507.11
1970-01	R 80 282.88	R 47 237.24	R 50 139.91	R 63 732.83	R 36 192.68	R 36 230.70	R 148 030.38	R 131 655.68	R 124 663.77
1971-01	R 209 922.13	R 176 844.75	R 139 256.91	R 204 871.94	R 167 834.38	R 132 029.90	R 199 980.54	R 184 912.83	R 163 268.90
1972-01	R 238 257.26	R 240 674.68	R 183 214.12	R 236 655.90	R 238 489.82	R 173 857.68	R 218 237.59	R 214 531.38	R 188 865.40
1973-01	R 174 963.91	R 106 097.55	R 127 373.86	R 164 001.67	R 92 153.24	R 101 521.97	R 176 234.89	R 157 017.14	R 156 938.18
1974-01	R 185 752.73	R 147 196.54	R 107 654.93	R 170 380.94	R 128 824.30	R 94 844.86	R 210 084.89	R 199 010.68	R 178 960.89
1975-01	R 272 323.87	R 174 968.63	R 150 203.00	R 292 111.15	R 170 075.16	R 140 402.58	R 205 100.38	R 163 899.57	R 156 625.24
1976-01	R 368 848.59	R 330 158.87	R 292 763.23	R 399 200.39	R 355 207.74	R 298 584.81	R 340 497.66	R 297 825.18	R 266 536.48
1977-01	R 498 618.17	R 407 644.82	R 342 267.42	R 565 030.99	R 435 723.05	R 343 612.31	R 518 584.58	R 414 674.07	R 344 144.22
1978-01	R 422 752.15	R 459 243.91	R 343 151.52	R 452 685.04	R 530 216.57	R 354 269.64	R 427 940.01	R 456 239.71	R 342 445.48
1979-01	R 478 773.21	R 391 401.30	R 311 400.20	R 549 369.55	R 424 509.04	R 316 833.02	R 439 314.89	R 364 639.10	R 303 094.35
1980-01	R 307 749.63	R 234 880.06	R 202 123.80	R 343 079.83	R 245 699.81	R 202 003.48	R 231 960.75	R 207 969.76	R 203 930.59
1981-01	R 256 017.35	R 136 257.68	R 124 832.19	R 312 569.76	R 142 917.98	R 127 266.67	R 201 400.30	R 120 727.01	R 114 663.14
1982-01	R 300 127.05	R 278 783.21	R 249 366.78	R 357 602.74	R 333 017.38	R 277 576.31	R 283 157.23	R 252 650.15	R 223 400.26
1983-01	R 340 992.53	R 280 280.05	R 209 175.40	R 378 372.46	R 295 111.95	R 204 281.57	R 247 778.36	R 216 321.98	R 198 654.16
1984-01	R 381 949.63	R 297 606.23	R 221 095.63	R 482 289.16	R 355 766.27	R 235 790.65	R 338 568.46	R 255 970.81	R 198 108.23
1985-01	R 536 219.78	R 291 990.89	R 208 005.15	R 744 933.35	R 353 700.23	R 218 436.85	R 570 732.53	R 293 390.97	R 207 666.26
1986-01	R 518 055.24	R 288 270.25	R 243 211.04	R 712 626.05	R 361 164.89	R 275 358.15	R 502 872.60	R 266 143.86	R 220 274.66
1987-01	R 353 306.81	R 226 177.63	R 162 101.06	R 419 075.27	R 250 563.62	R 160 764.18	R 244 667.28	R 139 909.38	R 116 691.78
1988-01	R 360 154.74	R 396 533.87	R 237 755.36	R 474 304.89	R 546 574.68	R 283 159.21	R 388 435.22	R 417 459.34	R 234 851.25
1989-01	R 430 415.60	R 484 993.15	R 229 933.52	R 543 132.08	R 621 229.39	R 251 324.64	R 438 077.52	R 471 907.41	R 219 470.73

Table D.1C: Present values of composite annuity strategies minus pure living annuity strategies – asset allocation C with life annuity (0%)

	Composite with life annuity (0%)								
Asset allocation	C								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-C-a-55-0%]	C[Liv-C-a-60-0%]	C[Liv-C-a-65-0%]	C[Liv-C-b-55-0%]	C[Liv-C-b-60-0%]	C[Liv-C-b-65-0%]	C[Liv-C-c-55-0%]	C[Liv-C-c-60-0%]	C[Liv-C-c-65-0%]
1960-01	R 335 741.84	R 160 512.22	R 300 579.35	R 264 678.05	R 178 517.42	R 260 902.51	R 297 795.51	R 154 322.81	R 274 440.10
1961-01	R 474 911.95	R 352 103.65	R 367 902.07	R 462 479.52	R 340 941.08	R 368 592.88	R 479 347.54	R 342 153.30	R 367 904.27
1962-01	R 565 349.20	R 452 604.25	R 310 897.63	R 570 495.27	R 437 773.70	R 313 748.32	R 579 498.43	R 446 635.86	R 306 338.34
1963-01	R 422 195.29	R 352 107.91	R 186 408.54	R 382 359.49	R 309 114.91	R 212 048.28	R 385 942.34	R 314 146.67	R 197 794.14
1964-01	R 313 741.68	R 268 563.05	R 152 288.45	R 273 558.75	R 225 332.66	R 179 111.41	R 270 544.77	R 235 973.60	R 185 533.79
1965-01	R 327 637.41	R 312 165.52	R 162 368.24	R 271 935.22	R 229 733.49	R 163 536.05	R 262 125.39	R 231 776.43	R 180 392.99
1966-01	R 416 393.32	R 278 455.38	R 249 462.66	R 364 782.56	R 232 013.64	R 204 919.16	R 312 436.48	R 215 959.12	R 227 776.46
1967-01	R 264 041.93	R 209 448.78	R 199 323.85	R 221 350.80	R 168 499.54	R 159 501.51	R 215 014.92	R 172 025.91	R 189 326.21
1968-01	R 265 737.09	R 213 670.65	R 152 902.65	R 212 345.35	R 155 443.58	R 119 701.33	R 203 618.01	R 184 477.17	R 176 832.02
1969-01	R 177 338.40	R 138 962.67	R 84 126.06	R 56 230.38	R 38 599.47	R 31 133.50	R 182 302.92	R 172 611.55	R 157 214.98
1970-01	R 213 896.97	R 155 995.37	R 139 021.31	R 174 804.51	R 117 554.71	R 90 778.87	R 168 052.15	R 142 594.85	R 142 990.58
1971-01	R 477 767.39	R 405 471.87	R 302 637.34	R 490 801.16	R 406 200.59	R 288 838.27	R 438 755.09	R 362 303.14	R 271 871.25
1972-01	R 489 508.17	R 525 826.49	R 385 823.76	R 498 198.92	R 559 942.16	R 382 169.74	R 461 957.66	R 472 516.06	R 343 415.41
1973-01	R 348 151.23	R 239 271.25	R 278 063.31	R 336 540.42	R 208 636.83	R 231 758.81	R 249 662.90	R 195 266.57	R 202 350.34
1974-01	R 384 457.86	R 326 717.39	R 232 483.03	R 354 509.52	R 287 228.83	R 190 856.65	R 289 424.02	R 262 135.44	R 224 488.84
1975-01	R 498 337.38	R 329 494.27	R 293 228.08	R 538 928.31	R 316 567.81	R 275 542.18	R 442 358.64	R 291 985.67	R 248 330.87
1976-01	R 683 915.47	R 608 773.13	R 569 786.82	R 743 228.26	R 661 062.97	R 609 010.41	R 699 073.21	R 607 495.26	R 551 826.09
1977-01	R 872 855.10	R 765 258.83	R 625 041.79	R 971 110.75	R 836 962.25	R 637 014.80	R 966 671.42	R 830 317.54	R 641 105.59
1978-01	R 713 262.66	R 818 869.58	R 631 075.79	R 742 909.04	R 962 051.86	R 672 761.94	R 746 760.41	R 910 953.45	R 658 012.04
1979-01	R 767 319.40	R 673 393.50	R 530 253.06	R 874 695.32	R 744 383.69	R 544 779.35	R 812 450.94	R 696 119.78	R 535 417.42
1980-01	R 429 355.68	R 353 432.13	R 318 050.92	R 481 223.99	R 375 893.26	R 332 759.85	R 390 790.86	R 325 081.09	R 287 470.41
1981-01	R 313 181.98	R 182 883.77	R 191 988.44	R 376 677.52	R 183 150.25	R 201 376.85	R 296 147.70	R 178 293.14	R 180 083.36
1982-01	R 340 987.05	R 357 150.20	R 350 467.15	R 380 414.47	R 417 455.35	R 398 955.71	R 345 541.87	R 354 544.18	R 338 701.40
1983-01	R 380 352.92	R 338 135.94	R 287 787.88	R 420 729.43	R 362 576.73	R 288 799.36	R 327 579.45	R 286 513.09	R 254 372.58
1984-01	R 390 497.49	R 332 834.17	R 264 640.20	R 482 158.94	R 393 037.97	R 279 345.37	R 377 834.49	R 313 579.86	R 252 797.02
1985-01	R 572 774.29	R 287 500.80	R 233 180.58	R 795 429.37	R 324 157.37	R 230 767.60	R 641 954.06	R 295 955.62	R 234 337.82
1986-01	R 522 406.28	R 238 578.47	R 235 245.80	R 727 276.97	R 290 604.89	R 261 492.33	R 498 402.75	R 221 187.49	R 215 778.94
1987-01	R 332 468.94	R 153 981.57	R 123 350.45	R 378 875.66	R 159 312.88	R 114 879.83	R 177 765.14	R 80 707.39	R 98 962.06
1988-01	R 334 583.74	R 384 277.69	R 226 608.51	R 441 774.71	R 547 123.49	R 270 820.26	R 368 393.96	R 420 724.62	R 231 965.10
1989-01	R 420 436.91	R 488 363.46	R 181 564.78	R 530 471.59	R 625 464.67	R 191 120.91	R 416 390.93	R 457 082.17	R 177 228.79

Table D.1D: Present values of composite annuity strategies minus pure living annuity strategies – asset allocation A with life annuity (5%)

	Composite with life annuity (5%)								
Asset allocation	A								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-A-a-55-5%]	C[Liv-A-a-60-5%]	C[Liv-A-a-65-5%]	C[Liv-A-b-55-5%]	C[Liv-A-b-60-5%]	C[Liv-A-b-65-5%]	C[Liv-A-c-55-5%]	C[Liv-A-c-60-5%]	C[Liv-A-c-65-5%]
1960-01	R 18 933.19	R -3 615.97	R 87 772.18	R 75 302.63	R 66 814.46	R 120 427.78	R 102 884.54	R 79 313.37	R 123 432.91
1961-01	R 40 369.27	R 51 873.38	R 85 850.00	R 94 312.78	R 95 882.39	R 131 579.63	R 120 869.11	R 112 421.42	R 126 418.31
1962-01	R 72 086.31	R 71 212.70	R 77 785.42	R 91 735.43	R 94 542.63	R 123 843.02	R 131 357.24	R 122 187.90	R 121 904.28
1963-01	R 48 001.70	R 33 600.72	R 30 087.44	R 94 858.88	R 82 824.55	R 95 640.43	R 182 269.77	R 153 826.77	R 134 695.68
1964-01	R 28 799.78	R 15 581.73	R 24 452.11	R 81 946.35	R 70 197.73	R 82 554.14	R 200 638.75	R 170 110.39	R 150 453.84
1965-01	R 27 332.50	R 36 438.81	R 37 745.45	R 73 662.93	R 67 256.91	R 79 655.33	R 186 978.10	R 163 497.83	R 143 723.92
1966-01	R 48 404.81	R 28 803.43	R 67 955.64	R 68 392.35	R 58 886.81	R 88 596.11	R 180 408.17	R 156 620.15	R 154 294.45
1967-01	R 28 858.27	R 11 476.31	R 42 579.51	R 55 076.30	R 46 608.98	R 70 605.36	R 165 871.45	R 143 586.63	R 137 745.49
1968-01	R 33 072.06	R 12 937.49	R 25 210.58	R 51 755.32	R 42 625.58	R 57 057.10	R 191 249.52	R 167 895.78	R 150 983.18
1969-01	R 17 735.44	R 1 905.97	R 19 773.64	R 31 122.13	R 21 723.25	R 37 574.20	R 204 782.91	R 182 151.38	R 164 244.28
1970-01	R 33 980.62	R 11 644.76	R 22 055.96	R 44 450.92	R 33 479.08	R 42 926.37	R 201 114.14	R 178 578.43	R 158 835.69
1971-01	R 77 271.97	R 61 761.37	R 57 024.95	R 77 949.93	R 65 713.81	R 71 462.66	R 196 894.74	R 181 472.64	R 162 828.36
1972-01	R 99 654.26	R 88 679.51	R 74 714.93	R 96 399.28	R 85 157.73	R 79 834.54	R 193 931.34	R 183 227.31	R 165 698.65
1973-01	R 86 884.66	R 44 128.95	R 56 126.98	R 76 963.11	R 45 842.69	R 57 413.71	R 199 490.11	R 181 618.22	R 167 381.03
1974-01	R 80 748.06	R 55 738.44	R 46 798.09	R 76 072.47	R 55 934.12	R 55 815.76	R 212 190.44	R 197 054.82	R 177 804.40
1975-01	R 134 679.33	R 86 184.43	R 73 936.14	R 134 760.48	R 83 690.38	R 74 672.88	R 177 097.28	R 166 389.01	R 155 683.36
1976-01	R 169 379.71	R 155 984.66	R 131 403.87	R 175 908.20	R 157 537.72	R 128 795.45	R 185 586.21	R 187 384.96	R 182 545.32
1977-01	R 240 838.54	R 178 086.86	R 163 091.19	R 268 797.27	R 180 787.25	R 159 192.46	R 200 161.10	R 181 195.80	R 181 544.91
1978-01	R 215 412.48	R 220 899.64	R 162 073.65	R 229 850.47	R 237 640.04	R 159 112.01	R 195 502.06	R 206 867.88	R 191 015.92
1979-01	R 273 255.60	R 204 964.28	R 169 959.03	R 293 283.72	R 206 432.58	R 167 073.34	R 255 800.04	R 245 370.46	R 235 468.52
1980-01	R 221 606.41	R 159 320.64	R 135 157.84	R 225 773.73	R 152 578.22	R 124 745.27	R 212 691.69	R 206 579.56	R 202 394.06
1981-01	R 199 183.81	R 104 970.36	R 88 129.24	R 236 383.03	R 109 474.22	R 86 361.56	R 114 841.74	R 101 426.29	R 114 878.12
1982-01	R 240 763.98	R 203 673.02	R 175 424.62	R 298 785.40	R 241 406.56	R 186 561.49	R 182 949.92	R 151 769.65	R 150 044.23
1983-01	R 303 907.77	R 237 221.83	R 163 043.00	R 321 120.66	R 234 645.64	R 153 270.71	R 195 170.40	R 195 020.09	R 192 697.52
1984-01	R 336 570.03	R 249 217.52	R 187 510.88	R 428 055.90	R 293 272.96	R 196 787.60	R 246 006.00	R 178 526.34	R 157 905.46
1985-01	R 418 235.26	R 258 874.52	R 177 715.36	R 593 435.31	R 332 156.29	R 193 306.13	R 403 030.80	R 237 439.45	R 169 269.56
1986-01	R 410 257.53	R 289 578.11	R 236 066.38	R 574 986.41	R 375 355.96	R 269 482.83	R 388 428.77	R 256 951.21	R 207 647.91
1987-01	R 296 210.75	R 267 442.95	R 196 760.25	R 363 817.79	R 310 801.92	R 202 993.09	R 219 716.64	R 180 911.18	R 140 445.78
1988-01	R 281 013.60	R 347 604.84	R 233 500.11	R 382 341.21	R 468 728.92	R 272 216.79	R 289 506.57	R 340 099.19	R 215 506.58
1989-01	R 312 613.35	R 402 836.76	R 260 519.18	R 407 163.46	R 517 993.12	R 291 283.98	R 317 230.83	R 390 757.21	R 241 814.84

Table D.1E: Present values of composite annuity strategies minus pure living annuity strategies – asset allocation B with life annuity (5%)

	Composite with life annuity (5%)								
Asset allocation	B								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-B-a-55-5%]	C[Liv-B-a-60-5%]	C[Liv-B-a-65-5%]	C[Liv-B-b-55-5%]	C[Liv-B-b-60-5%]	C[Liv-B-b-65-5%]	C[Liv-B-c-55-5%]	C[Liv-B-c-60-5%]	C[Liv-B-c-65-5%]
1960-01	R 179 228.60	R 95 830.01	R 206 989.61	R 173 886.20	R 145 956.16	R 206 186.42	R 168 863.66	R 126 295.55	R 195 480.10
1961-01	R 242 422.21	R 207 374.63	R 232 755.71	R 235 502.20	R 213 741.29	R 247 693.13	R 233 778.84	R 202 369.99	R 238 415.91
1962-01	R 296 000.08	R 256 916.60	R 205 387.06	R 265 797.94	R 230 452.23	R 225 493.76	R 263 685.33	R 229 246.84	R 213 938.87
1963-01	R 228 515.51	R 194 140.19	R 127 135.25	R 210 872.47	R 191 943.03	R 181 156.90	R 234 383.88	R 216 882.55	R 177 608.39
1964-01	R 174 964.37	R 148 995.63	R 108 979.20	R 175 059.05	R 156 174.47	R 155 458.06	R 236 079.83	R 213 808.52	R 183 970.07
1965-01	R 178 256.13	R 180 743.62	R 122 490.07	R 164 564.40	R 152 855.67	R 146 427.48	R 220 696.52	R 209 299.96	R 181 632.41
1966-01	R 221 559.37	R 161 142.62	R 175 840.88	R 185 410.29	R 142 451.21	R 162 416.81	R 223 697.90	R 196 647.09	R 205 912.09
1967-01	R 157 671.24	R 123 246.45	R 139 252.89	R 144 887.48	R 116 905.67	R 133 576.97	R 198 163.08	R 176 193.19	R 182 488.47
1968-01	R 158 103.68	R 122 808.96	R 107 467.09	R 136 732.81	R 107 507.32	R 106 998.78	R 216 807.57	R 196 903.51	R 184 175.12
1969-01	R 110 732.12	R 83 148.08	R 72 836.18	R 68 268.20	R 51 507.50	R 57 024.21	R 221 011.04	R 201 300.87	R 184 140.87
1970-01	R 137 516.81	R 98 444.88	R 96 477.47	R 120 966.76	R 87 400.32	R 82 568.26	R 205 264.31	R 182 863.32	R 171 001.33
1971-01	R 260 476.37	R 222 844.78	R 181 736.47	R 255 426.18	R 213 834.41	R 174 509.46	R 250 534.78	R 230 912.86	R 205 748.46
1972-01	R 284 740.58	R 283 585.95	R 223 481.28	R 283 139.22	R 281 401.09	R 214 124.84	R 264 720.91	R 257 442.65	R 229 132.56
1973-01	R 221 834.71	R 149 266.66	R 167 460.16	R 210 872.47	R 135 322.35	R 141 608.27	R 223 105.69	R 200 186.25	R 197 024.48
1974-01	R 230 927.82	R 189 048.93	R 146 648.45	R 215 556.03	R 170 676.69	R 133 838.38	R 255 259.98	R 240 863.07	R 217 954.41
1975-01	R 312 110.93	R 213 410.94	R 187 238.76	R 331 898.21	R 208 517.47	R 177 438.34	R 244 887.44	R 202 341.88	R 193 661.00
1976-01	R 405 051.22	R 366 503.33	R 328 697.29	R 435 403.02	R 391 552.20	R 334 518.87	R 376 700.29	R 334 169.64	R 302 470.54
1977-01	R 528 148.86	R 439 546.22	R 375 570.50	R 594 561.68	R 467 624.45	R 376 915.39	R 548 115.27	R 446 575.47	R 377 447.30
1978-01	R 452 805.11	R 491 691.38	R 377 016.36	R 482 738.00	R 562 664.04	R 388 134.48	R 457 992.97	R 488 687.18	R 376 310.32
1979-01	R 515 290.43	R 428 335.69	R 348 120.20	R 585 886.77	R 461 443.43	R 353 553.02	R 475 832.11	R 401 573.49	R 339 814.35
1980-01	R 343 580.86	R 271 606.49	R 239 202.47	R 378 911.06	R 282 426.24	R 239 082.15	R 267 791.98	R 244 696.19	R 241 009.26
1981-01	R 269 752.50	R 158 562.01	R 154 035.31	R 326 304.91	R 165 222.31	R 156 469.79	R 215 135.45	R 143 031.34	R 143 866.26
1982-01	R 299 858.96	R 291 656.97	R 273 653.52	R 357 334.65	R 345 891.14	R 301 863.05	R 282 889.14	R 265 523.91	R 247 687.00
1983-01	R 362 793.05	R 307 752.45	R 241 999.87	R 400 172.98	R 322 584.35	R 237 106.04	R 269 578.88	R 243 794.38	R 231 478.63
1984-01	R 371 748.99	R 303 503.58	R 241 749.65	R 472 088.52	R 361 663.62	R 256 444.67	R 328 367.82	R 261 868.16	R 218 762.25
1985-01	R 493 482.96	R 276 528.53	R 216 704.29	R 702 196.53	R 338 237.87	R 227 135.99	R 527 995.71	R 277 928.61	R 216 365.40
1986-01	R 456 618.08	R 261 246.90	R 246 123.47	R 651 188.89	R 334 141.54	R 278 270.58	R 441 435.44	R 239 120.51	R 223 187.09
1987-01	R 310 189.36	R 211 404.41	R 172 571.27	R 375 957.82	R 235 790.40	R 171 234.39	R 201 549.83	R 125 136.16	R 127 161.99
1988-01	R 296 746.09	R 367 773.61	R 241 117.04	R 410 896.24	R 517 814.42	R 286 520.89	R 325 026.57	R 388 699.08	R 238 212.93
1989-01	R 352 326.69	R 445 197.60	R 227 848.58	R 465 043.17	R 581 433.84	R 249 239.70	R 359 988.61	R 432 111.86	R 217 385.79

Table D.1F: Present values of composite annuity strategies minus pure living annuity strategies – asset allocation C with life annuity (5%)

	Composite with life annuity (5%)								
Asset allocation	C								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	C[Liv-C-a-55-5%]	C[Liv-C-a-60-5%]	C[Liv-C-a-65-5%]	C[Liv-C-b-55-5%]	C[Liv-C-b-60-5%]	C[Liv-C-b-65-5%]	C[Liv-C-c-55-5%]	C[Liv-C-c-60-5%]	C[Liv-C-c-65-5%]
1960-01	R 393 013.95	R 209 167.79	R 347 131.41	R 321 950.16	R 227 172.99	R 307 454.57	R 355 067.62	R 202 978.38	R 320 992.16
1961-01	R 532 977.47	R 401 607.01	R 414 372.81	R 520 545.04	R 390 444.44	R 415 063.62	R 537 413.06	R 391 656.66	R 414 375.01
1962-01	R 620 465.37	R 499 859.50	R 355 631.27	R 625 611.44	R 485 028.95	R 358 481.96	R 634 614.60	R 493 891.11	R 351 071.98
1963-01	R 488 850.43	R 409 143.79	R 237 451.01	R 449 014.63	R 366 150.79	R 263 090.75	R 452 597.48	R 371 182.55	R 248 836.61
1964-01	R 379 705.70	R 325 449.13	R 202 826.92	R 339 522.77	R 282 218.74	R 229 649.88	R 336 508.79	R 292 859.68	R 236 072.26
1965-01	R 395 441.91	R 371 073.40	R 214 675.72	R 339 739.72	R 288 641.37	R 215 843.53	R 329 929.89	R 290 684.31	R 232 700.47
1966-01	R 477 353.04	R 331 964.95	R 297 783.07	R 425 742.28	R 285 523.21	R 253 239.57	R 373 396.20	R 269 468.69	R 276 096.87
1967-01	R 324 547.19	R 262 852.64	R 248 080.49	R 281 856.06	R 221 903.40	R 208 258.15	R 275 520.18	R 225 429.77	R 238 082.85
1968-01	R 324 560.04	R 265 788.07	R 200 376.14	R 271 168.30	R 207 561.00	R 167 174.82	R 262 440.96	R 236 594.59	R 224 305.51
1969-01	R 235 005.30	R 190 301.36	R 130 759.82	R 113 897.28	R 89 938.16	R 77 767.26	R 239 969.82	R 223 950.24	R 203 848.74
1970-01	R 271 130.90	R 207 203.01	R 185 358.87	R 232 038.44	R 168 762.35	R 137 116.43	R 225 286.08	R 193 802.49	R 189 328.14
1971-01	R 528 321.63	R 451 471.90	R 345 116.90	R 541 355.40	R 452 200.62	R 331 317.83	R 489 309.33	R 408 303.17	R 314 350.81
1972-01	R 535 991.49	R 568 737.76	R 426 090.92	R 544 682.24	R 602 853.43	R 422 436.90	R 508 440.98	R 515 427.33	R 383 682.57
1973-01	R 395 022.03	R 282 440.36	R 318 149.61	R 383 411.22	R 251 805.94	R 271 845.11	R 296 533.70	R 238 435.68	R 242 436.64
1974-01	R 429 632.95	R 368 569.78	R 271 476.55	R 399 684.61	R 329 081.22	R 229 850.17	R 334 599.11	R 303 987.83	R 263 482.36
1975-01	R 538 124.44	R 367 936.58	R 330 263.84	R 578 715.37	R 355 010.12	R 312 577.94	R 482 145.70	R 330 427.98	R 285 366.63
1976-01	R 720 118.10	R 645 117.59	R 605 720.88	R 779 430.89	R 697 407.43	R 644 944.47	R 735 275.84	R 643 839.72	R 587 760.15
1977-01	R 902 385.79	R 797 160.23	R 658 344.87	R 1 000 641.44	R 868 863.65	R 670 317.88	R 996 202.11	R 862 218.94	R 674 408.67
1978-01	R 743 315.62	R 851 317.05	R 664 940.63	R 772 962.00	R 994 499.33	R 706 626.78	R 776 813.37	R 943 400.92	R 691 876.88
1979-01	R 803 836.62	R 710 327.89	R 566 973.06	R 911 212.54	R 781 318.08	R 581 499.35	R 848 968.16	R 733 054.17	R 572 137.42
1980-01	R 465 186.91	R 390 158.56	R 355 129.59	R 517 055.22	R 412 619.69	R 369 838.52	R 426 622.09	R 361 807.52	R 324 549.08
1981-01	R 326 917.13	R 205 188.10	R 221 191.56	R 390 412.67	R 205 454.58	R 230 579.97	R 309 882.85	R 200 597.47	R 209 286.48
1982-01	R 340 718.96	R 370 023.96	R 374 753.89	R 380 146.38	R 430 329.11	R 423 242.45	R 345 273.78	R 367 417.94	R 362 988.14
1983-01	R 402 153.44	R 365 608.34	R 320 612.35	R 442 529.95	R 390 049.13	R 321 623.83	R 349 379.97	R 313 985.49	R 287 197.05
1984-01	R 380 296.85	R 338 731.52	R 285 294.22	R 471 958.30	R 398 935.32	R 299 999.39	R 367 633.85	R 319 477.21	R 273 451.04
1985-01	R 530 037.47	R 272 038.44	R 241 879.72	R 752 692.55	R 308 695.01	R 239 466.74	R 599 217.24	R 280 493.26	R 243 036.96
1986-01	R 460 969.12	R 211 555.12	R 238 158.23	R 665 839.81	R 263 581.54	R 264 404.76	R 436 965.59	R 194 164.14	R 218 691.37
1987-01	R 289 351.49	R 139 208.35	R 133 820.66	R 335 758.21	R 144 539.66	R 125 350.04	R 134 647.69	R 65 934.17	R 109 432.27
1988-01	R 271 175.09	R 355 517.43	R 229 970.19	R 378 366.06	R 518 363.23	R 274 181.94	R 304 985.31	R 391 964.36	R 235 326.78
1989-01	R 342 348.00	R 448 567.91	R 179 479.84	R 452 382.68	R 585 669.12	R 189 035.97	R 338 302.02	R 417 286.62	R 175 143.85

Appendix E

Present values of switching annuity strategies minus pure living annuity strategies

Table E.1A: Present values of switching annuity strategies minus pure living annuity strategies – asset allocation A to life annuity (0%)

	Switch to life annuity (0%)								
Asset allocation	A								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-A-a-55-0%]	S[Liv-A-a-60-0%]	S[Liv-A-a-65-0%]	S[Liv-A-b-55-0%]	S[Liv-A-b-60-0%]	S[Liv-A-b-65-0%]	S[Liv-A-c-55-0%]	S[Liv-A-c-60-0%]	S[Liv-A-c-65-0%]
1960-01	R 8 096.05	R 29 415.36	R 280 223.80	R 83 151.24	R 112 946.75	R 212 193.37	R 161 787.75	R 169 927.04	R 283 471.35
1961-01	R 52 539.96	R 133 197.27	R 251 188.95	R 121 004.20	R 163 604.43	R 226 827.40	R 201 499.70	R 231 438.81	R 274 888.85
1962-01	R 128 458.77	R 175 967.19	R 229 631.06	R 136 223.10	R 175 199.01	R 222 710.98	R 236 971.22	R 257 529.78	R 264 749.22
1963-01	R 37 344.58	R 75 193.82	R 136 679.77	R 78 414.78	R 97 674.22	R 119 878.52	R 271 273.88	R 265 344.89	R 235 245.70
1964-01	R 18 732.68	R 54 997.29	R 138 038.98	R 64 868.63	R 81 812.97	R 109 746.48	R 312 912.80	R 295 685.32	R 261 375.11
1965-01	R 41 752.81	R 121 302.03	R 185 196.02	R 69 939.70	R 95 777.54	R 119 264.74	R 311 245.16	R 306 616.63	R 266 985.44
1966-01	R 105 842.66	R 113 564.58	R 237 480.58	R 95 546.64	R 104 706.05	R 148 548.27	R 322 432.75	R 303 519.50	R 281 883.03
1967-01	R 104 323.90	R 110 647.39	R 209 107.70	R 107 178.77	R 113 014.58	R 139 302.87	R 331 734.29	R 309 627.69	R 276 400.32
1968-01	R 105 959.81	R 105 834.06	R 170 045.56	R 96 612.55	R 100 801.16	R 113 048.90	R 360 256.39	R 325 835.22	R 279 992.46
1969-01	R 114 703.78	R 121 470.05	R 197 806.26	R 84 025.41	R 82 959.05	R 104 871.27	R 403 560.06	R 374 565.56	R 332 163.11
1970-01	R 66 380.18	R 65 976.10	R 146 954.81	R 53 355.40	R 61 901.25	R 93 420.59	R 344 923.04	R 323 070.67	R 292 256.54
1971-01	R 60 974.75	R 73 614.34	R 132 967.28	R 51 955.03	R 62 353.75	R 109 884.81	R 267 341.55	R 262 026.78	R 236 880.10
1972-01	R 114 988.25	R 130 095.19	R 161 552.24	R 103 623.58	R 111 172.90	R 134 720.35	R 268 611.69	R 264 522.92	R 220 868.67
1973-01	R 149 159.24	R 97 341.41	R 176 609.73	R 113 740.74	R 75 968.66	R 120 647.27	R 320 059.43	R 290 835.17	R 263 575.05
1974-01	R 112 268.24	R 101 768.66	R 144 389.97	R 89 005.57	R 78 050.86	R 103 588.07	R 329 111.38	R 308 912.19	R 270 889.14
1975-01	R 211 012.17	R 152 258.98	R 189 496.50	R 208 747.59	R 139 041.87	R 162 042.30	R 264 664.37	R 260 117.89	R 233 756.91
1976-01	R 204 038.51	R 221 069.72	R 246 858.99	R 221 484.57	R 226 782.06	R 233 211.54	R 217 511.53	R 245 494.55	R 241 962.73
1977-01	R 232 862.91	R 156 419.09	R 222 680.16	R 298 003.78	R 178 018.00	R 242 492.67	R 151 062.96	R 151 454.71	R 208 504.69
1978-01	R 186 229.42	R 248 714.85	R 225 020.95	R 223 800.47	R 297 226.88	R 242 693.13	R 144 446.44	R 204 524.50	R 218 958.10
1979-01	R 298 472.02	R 221 384.49	R 246 822.32	R 341 570.11	R 226 532.48	R 232 813.96	R 255 685.88	R 265 397.93	R 263 720.84
1980-01	R 270 189.10	R 207 483.09	R 256 697.01	R 281 078.37	R 191 440.59	R 210 566.50	R 260 384.22	R 269 454.83	R 280 781.23
1981-01	R 350 799.28	R 202 439.43	R 247 555.78	R 426 365.85	R 215 419.39	R 244 980.88	R 189 255.41	R 180 287.96	R 215 136.22
1982-01	R 355 328.57	R 328 226.69	R 370 735.77	R 464 143.78	R 407 811.00	R 413 452.06	R 253 512.25	R 221 821.90	R 260 085.80
1983-01	R 408 774.82	R 340 295.81	R 303 048.34	R 448 373.37	R 337 528.05	R 265 898.07	R 219 184.82	R 246 909.69	R 254 122.52
1984-01	R 499 142.60	R 370 647.18	R 363 993.26	R 669 575.78	R 457 158.51	R 396 949.55	R 349 979.21	R 242 172.22	R 243 808.48
1985-01	R 630 559.03	R 364 503.44	R 331 249.32	R 937 112.15	R 494 926.91	R 400 036.37	R 618 514.71	R 331 964.37	R 282 967.78
1986-01	R 717 520.99	R 500 235.05	R 496 554.57	R 1 010 675.87	R 659 460.86	R 594 200.07	R 691 849.29	R 444 179.47	R 404 606.41
1987-01	R 520 797.19	R 503 744.44	R 465 121.42	R 642 890.30	R 589 596.93	R 487 879.11	R 413 733.40	R 356 113.14	R 304 607.52
1988-01	R 529 176.58	R 681 700.51	R 546 087.41	R 692 519.35	R 908 680.55	R 652 893.12	R 554 550.29	R 672 434.06	R 486 585.46
1989-01	R 569 540.78	R 768 037.62	R 574 605.33	R 720 000.43	R 984 166.70	R 666 252.40	R 589 957.05	R 751 394.05	R 509 734.92

Table E.1B: Present values of switching annuity strategies minus pure living annuity strategies – asset allocation B to life annuity (0%)

	Switch to life annuity (0%)								
Asset allocation	B								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-B-a-55-0%]	S[Liv-B-a-60-0%]	S[Liv-B-a-65-0%]	S[Liv-B-b-55-0%]	S[Liv-B-b-60-0%]	S[Liv-B-b-65-0%]	S[Liv-B-c-55-0%]	S[Liv-B-c-60-0%]	S[Liv-B-c-65-0%]
1960-01	R 148 471.69	R 64 584.78	R 399 174.34	R 123 764.28	R 135 943.41	R 304 956.78	R 131 106.30	R 122 277.66	R 341 878.08
1961-01	R 264 233.22	R 260 635.38	R 390 118.94	R 243 216.38	R 254 946.77	R 365 827.20	R 266 780.75	R 266 560.56	R 405 271.98
1962-01	R 396 306.70	R 374 684.87	R 337 134.32	R 335 339.09	R 311 987.85	R 338 788.49	R 352 435.83	R 336 430.93	R 360 045.98
1963-01	R 192 267.19	R 202 035.56	R 173 613.90	R 132 673.71	R 158 878.94	R 186 561.73	R 194 843.84	R 228 888.98	R 219 923.53
1964-01	R 155 815.14	R 174 114.90	R 184 304.05	R 120 479.68	R 136 067.05	R 166 780.43	R 252 404.30	R 264 015.49	R 245 257.53
1965-01	R 194 129.60	R 268 799.00	R 238 412.43	R 129 678.44	R 158 351.52	R 173 688.29	R 254 531.12	R 287 461.02	R 272 112.45
1966-01	R 343 369.49	R 273 038.90	R 360 997.92	R 242 354.50	R 192 151.80	R 245 900.42	R 321 344.86	R 303 438.08	R 337 040.40
1967-01	R 291 582.03	R 265 279.57	R 340 181.59	R 230 934.37	R 201 643.57	R 229 798.94	R 340 062.29	R 323 012.57	R 326 540.30
1968-01	R 296 858.81	R 268 550.72	R 285 262.64	R 218 740.12	R 187 547.05	R 178 840.27	R 367 764.65	R 342 650.25	R 306 594.37
1969-01	R 292 682.48	R 278 318.54	R 303 788.08	R 151 880.50	R 137 897.73	R 141 276.95	R 430 440.24	R 408 765.85	R 369 637.88
1970-01	R 184 480.19	R 160 168.61	R 241 655.37	R 138 071.27	R 114 579.41	R 144 037.42	R 297 463.57	R 285 631.32	R 287 370.63
1971-01	R 190 385.52	R 181 247.88	R 223 629.65	R 188 765.05	R 169 345.80	R 196 438.57	R 175 127.83	R 190 953.43	R 210 265.67
1972-01	R 254 805.17	R 309 966.28	R 298 549.36	R 263 786.46	R 316 862.02	R 280 346.49	R 212 172.05	R 243 058.11	R 244 303.51
1973-01	R 287 437.86	R 189 086.06	R 313 480.48	R 268 424.27	R 158 555.47	R 231 060.51	R 276 356.98	R 256 627.29	R 269 012.18
1974-01	R 236 523.40	R 210 392.37	R 226 418.14	R 214 044.62	R 175 204.28	R 170 862.33	R 278 008.92	R 285 708.37	R 263 905.61
1975-01	R 387 199.49	R 249 602.94	R 302 088.40	R 440 140.12	R 253 104.38	R 287 149.93	R 249 816.25	R 209 816.85	R 244 618.29
1976-01	R 354 693.81	R 358 590.91	R 428 842.70	R 427 047.78	R 429 074.17	R 475 036.01	R 303 285.73	R 290 111.12	R 334 271.38
1977-01	R 340 431.48	R 264 693.08	R 333 529.37	R 463 703.97	R 334 281.09	R 409 163.71	R 377 036.42	R 282 037.04	R 345 992.89
1978-01	R 272 869.33	R 441 929.80	R 380 641.14	R 342 293.59	R 613 169.23	R 484 180.95	R 284 761.23	R 439 927.16	R 377 838.55
1979-01	R 442 490.68	R 362 855.63	R 360 901.60	R 588 745.45	R 449 309.93	R 421 331.20	R 364 502.13	R 300 408.34	R 296 848.75
1980-01	R 289 657.87	R 236 647.84	R 320 613.80	R 360 995.11	R 263 255.03	R 324 846.00	R 158 097.96	R 181 383.79	R 246 659.64
1981-01	R 378 087.07	R 211 001.40	R 306 732.72	R 491 477.12	R 234 331.48	R 335 235.31	R 276 214.61	R 172 806.70	R 229 225.83
1982-01	R 293 195.30	R 349 329.06	R 455 111.60	R 391 019.06	R 460 309.91	R 550 178.78	R 268 083.94	R 297 498.54	R 364 805.33
1983-01	R 415 831.17	R 380 936.44	R 379 142.76	R 494 298.76	R 417 204.57	R 370 488.93	R 248 333.66	R 245 395.15	R 262 088.74
1984-01	R 450 755.48	R 374 203.74	R 392 723.59	R 630 899.41	R 487 113.31	R 451 551.86	R 387 558.97	R 301 709.20	R 301 477.04
1985-01	R 572 987.27	R 226 015.15	R 290 919.84	R 921 141.79	R 314 837.33	R 355 781.18	R 647 405.25	R 235 554.37	R 276 221.12
1986-01	R 740 160.23	R 384 420.18	R 475 723.99	R 1 088 097.92	R 515 537.37	R 574 534.66	R 726 818.49	R 350 570.20	R 400 564.64
1987-01	R 525 202.78	R 373 332.43	R 406 964.96	R 650 039.83	R 425 709.33	R 413 514.53	R 365 018.71	R 234 545.48	R 268 385.73
1988-01	R 540 607.93	R 699 502.95	R 535 652.04	R 728 645.87	R 987 819.95	R 671 806.76	R 593 630.40	R 740 848.11	R 517 025.70
1989-01	R 688 622.34	R 877 900.76	R 511 246.97	R 885 791.03	R 1 146 109.05	R 594 111.25	R 710 047.52	R 854 175.85	R 461 049.95

Table E.1C: Present values of switching annuity strategies minus pure living annuity strategies – asset allocation C to life annuity (0%)

	Switch to life annuity (0%)								
Asset allocation	C								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-C-a-55-0%]	S[Liv-C-a-60-0%]	S[Liv-C-a-65-0%]	S[Liv-C-b-55-0%]	S[Liv-C-b-60-0%]	S[Liv-C-b-65-0%]	S[Liv-C-c-55-0%]	S[Liv-C-c-60-0%]	S[Liv-C-c-65-0%]
1960-01	R 370 200.42	R 104 366.92	R 543 308.97	R 240 826.41	R 143 647.74	R 415 188.47	R 317 851.97	R 114 055.88	R 495 207.06
1961-01	R 625 088.97	R 438 080.39	R 573 410.51	R 633 327.02	R 445 682.72	R 594 992.89	R 693 893.70	R 482 262.20	R 651 387.08
1962-01	R 842 599.98	R 665 469.70	R 469 363.08	R 889 140.63	R 670 502.65	R 505 497.24	R 928 423.49	R 715 036.92	R 535 025.84
1963-01	R 471 625.01	R 404 997.96	R 211 532.53	R 392 006.47	R 311 594.83	R 223 187.05	R 411 510.98	R 338 907.20	R 231 083.95
1964-01	R 393 555.85	R 363 588.13	R 236 160.63	R 301 466.10	R 253 722.44	R 222 960.34	R 304 641.23	R 287 008.12	R 257 743.62
1965-01	R 463 926.83	R 494 438.24	R 295 898.54	R 340 373.78	R 305 195.80	R 229 841.53	R 331 252.27	R 323 362.56	R 289 999.52
1966-01	R 747 635.39	R 510 475.02	R 512 639.41	R 637 553.28	R 399 934.98	R 372 316.56	R 534 903.27	R 370 337.14	R 421 898.63
1967-01	R 563 718.17	R 483 644.22	R 501 761.33	R 457 382.74	R 367 132.34	R 346 511.00	R 446 992.07	R 376 673.24	R 407 971.37
1968-01	R 580 387.15	R 506 830.27	R 429 693.45	R 448 032.61	R 351 347.86	R 273 973.20	R 419 826.93	R 388 225.83	R 357 225.38
1969-01	R 541 012.41	R 494 331.30	R 425 383.07	R 245 008.31	R 216 306.15	R 186 733.64	R 470 103.94	R 457 249.48	R 413 426.27
1970-01	R 361 489.66	R 297 788.71	R 366 432.04	R 287 304.17	R 218 111.26	R 224 421.40	R 274 707.15	R 260 189.80	R 296 685.38
1971-01	R 427 449.95	R 370 231.47	R 356 606.62	R 465 969.82	R 388 764.13	R 345 834.76	R 379 972.23	R 311 138.05	R 281 450.05
1972-01	R 475 734.35	R 625 588.23	R 513 384.86	R 512 394.95	R 718 847.18	R 538 390.82	R 443 467.17	R 536 838.13	R 409 414.70
1973-01	R 483 748.77	R 320 759.07	R 518 439.30	R 482 352.44	R 279 787.45	R 424 224.70	R 310 105.21	R 244 400.40	R 308 046.39
1974-01	R 420 640.98	R 379 079.30	R 336 453.86	R 398 271.05	R 335 354.29	R 260 528.77	R 273 912.16	R 276 478.24	R 263 992.65
1975-01	R 628 327.22	R 373 868.76	R 455 400.58	R 739 097.94	R 383 965.88	R 460 800.47	R 543 829.05	R 318 378.36	R 343 996.69
1976-01	R 557 362.13	R 540 542.34	R 706 761.12	R 683 214.91	R 671 480.23	R 859 677.92	R 605 763.55	R 560 081.59	R 684 279.85
1977-01	R 433 400.35	R 402 524.39	R 470 913.26	R 577 748.50	R 528 063.73	R 595 686.48	R 571 526.40	R 512 298.20	R 553 136.18
1978-01	R 352 492.63	R 712 852.28	R 606 970.15	R 418 928.55	R 1 042 642.29	R 836 935.04	R 410 966.88	R 911 854.59	R 725 618.20
1979-01	R 590 267.92	R 543 283.56	R 497 892.97	R 808 368.83	R 718 242.52	R 636 530.29	R 677 868.85	R 595 557.55	R 525 216.15
1980-01	R 262 919.46	R 240 022.05	R 382 557.52	R 353 971.81	R 287 562.86	R 441 585.39	R 206 858.24	R 193 508.88	R 283 116.85
1981-01	R 374 526.99	R 201 626.48	R 364 548.31	R 502 952.11	R 218 402.38	R 430 833.95	R 347 147.26	R 192 732.15	R 310 710.97
1982-01	R 181 048.52	R 339 464.94	R 536 579.72	R 234 476.67	R 459 371.53	R 690 780.88	R 190 890.28	R 335 368.16	R 496 016.54
1983-01	R 389 355.67	R 399 678.45	R 454 580.23	R 475 865.11	R 463 035.37	R 480 322.89	R 296 030.82	R 287 861.14	R 309 638.37
1984-01	R 360 498.32	R 348 661.46	R 404 907.99	R 517 045.04	R 465 428.59	R 479 924.33	R 350 512.00	R 318 860.13	R 350 978.28
1985-01	R 445 539.27	R 49 573.87	R 227 395.59	R 792 770.50	R 67 613.04	R 269 651.03	R 571 053.42	R 64 380.65	R 228 540.89
1986-01	R 707 306.60	R 249 378.53	R 434 103.25	R 1 073 899.36	R 338 320.21	R 524 243.52	R 676 351.38	R 226 259.70	R 369 807.49
1987-01	R 486 805.44	R 232 713.90	R 334 289.51	R 581 838.62	R 252 849.35	R 324 417.60	R 246 800.03	R 128 361.50	R 235 888.34
1988-01	R 500 864.25	R 678 433.55	R 504 503.51	R 682 304.69	R 1 001 595.66	R 656 161.28	R 559 583.73	R 749 804.47	R 514 652.68
1989-01	R 739 393.33	R 936 148.42	R 434 721.81	R 945 024.25	R 1 218 024.20	R 502 140.56	R 735 117.95	R 872 365.51	R 392 796.47

Table E.1D: Present values of switching annuity strategies minus pure living annuity strategies – asset allocation A to life annuity (5%)

	Switch to life annuity (5%)								
Asset allocation	A								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-A-a-55-5%]	S[Liv-A-a-60-5%]	S[Liv-A-a-65-5%]	S[Liv-A-b-55-5%]	S[Liv-A-b-60-5%]	S[Liv-A-b-65-5%]	S[Liv-A-c-55-5%]	S[Liv-A-c-60-5%]	S[Liv-A-c-65-5%]
1960-01	R 84 305.62	R 88 640.85	R 324 116.31	R 150 330.71	R 159 885.52	R 239 876.15	R 239 089.17	R 226 227.73	R 319 035.29
1961-01	R 112 858.21	R 180 775.58	R 287 892.61	R 178 866.58	R 205 480.52	R 253 108.18	R 265 814.55	R 279 355.36	R 306 979.58
1962-01	R 182 583.47	R 219 014.47	R 263 646.52	R 189 825.66	R 214 572.55	R 248 643.81	R 295 069.47	R 301 141.28	R 294 619.83
1963-01	R 89 529.81	R 116 434.23	R 168 849.86	R 121 344.17	R 127 675.82	R 139 640.18	R 319 145.54	R 299 646.17	R 257 333.67
1964-01	R 64 767.60	R 91 516.92	R 166 569.95	R 100 980.05	R 106 493.06	R 126 398.01	R 351 590.38	R 322 703.93	R 278 876.56
1965-01	R 80 782.10	R 152 894.55	R 210 763.31	R 101 190.34	R 117 443.59	R 133 859.85	R 345 223.52	R 330 890.63	R 282 800.45
1966-01	R 141 664.81	R 142 819.06	R 261 680.69	R 127 533.95	R 127 895.55	R 163 893.82	R 354 606.71	R 326 888.71	R 297 798.42
1967-01	R 135 304.06	R 136 259.83	R 231 078.95	R 135 000.75	R 133 347.84	R 153 346.77	R 359 357.14	R 329 827.43	R 291 035.08
1968-01	R 136 134.01	R 130 587.84	R 191 070.97	R 122 120.43	R 119 106.43	R 125 855.57	R 383 340.10	R 342 829.93	R 292 458.79
1969-01	R 145 664.13	R 146 283.56	R 217 807.79	R 106 058.71	R 98 394.94	R 115 433.19	R 422 663.80	R 388 648.41	R 342 302.10
1970-01	R 104 007.39	R 96 136.37	R 171 135.36	R 83 503.45	R 82 844.80	R 107 197.30	R 368 413.22	R 340 641.54	R 304 888.24
1971-01	R 96 549.13	R 103 896.89	R 159 990.14	R 88 459.95	R 90 709.87	R 130 610.39	R 296 016.63	R 282 607.37	R 252 583.60
1972-01	R 145 379.40	R 157 013.19	R 186 974.29	R 137 252.10	R 138 430.10	R 156 267.69	R 294 651.74	R 284 155.30	R 235 513.57
1973-01	R 185 547.23	R 127 354.49	R 201 807.37	R 148 458.34	R 101 990.94	R 138 220.71	R 343 852.12	R 308 087.02	R 275 896.22
1974-01	R 138 040.95	R 125 274.39	R 166 726.74	R 115 150.26	R 99 085.41	R 119 267.66	R 346 215.48	R 322 372.45	R 281 446.08
1975-01	R 230 624.34	R 173 219.97	R 212 183.52	R 233 484.73	R 161 835.57	R 182 327.14	R 283 166.49	R 275 761.29	R 246 939.98
1976-01	R 222 943.44	R 243 590.12	R 272 674.94	R 248 451.88	R 253 588.55	R 258 835.22	R 238 130.39	R 264 515.22	R 258 744.77
1977-01	R 266 370.11	R 191 172.29	R 258 176.13	R 345 685.41	R 222 500.71	R 282 891.75	R 189 610.42	R 185 634.71	R 236 469.38
1978-01	R 211 664.36	R 278 135.26	R 257 286.05	R 262 070.39	R 335 180.21	R 278 846.58	R 174 463.44	R 232 562.78	R 242 513.22
1979-01	R 316 775.80	R 245 118.07	R 274 276.64	R 369 009.36	R 254 898.27	R 259 856.64	R 275 033.15	R 283 696.99	R 279 999.05
1980-01	R 290 308.79	R 231 998.49	R 283 697.27	R 308 257.13	R 218 052.31	R 234 069.62	R 277 989.75	R 285 605.16	R 294 962.64
1981-01	R 368 727.11	R 227 463.07	R 276 637.05	R 455 626.04	R 246 734.15	R 275 021.56	R 210 901.26	R 201 619.53	R 233 140.41
1982-01	R 372 141.80	R 355 945.39	R 405 321.35	R 497 016.79	R 446 020.24	R 452 820.94	R 279 021.63	R 249 681.37	R 285 279.24
1983-01	R 433 082.49	R 370 054.47	R 335 655.29	R 482 904.01	R 371 310.43	R 295 764.63	R 242 841.06	R 267 809.42	R 271 412.09
1984-01	R 546 854.68	R 418 552.33	R 409 828.04	R 737 024.97	R 517 628.68	R 447 792.67	R 400 510.46	R 284 291.15	R 274 215.94
1985-01	R 644 760.74	R 398 308.06	R 376 834.11	R 975 782.59	R 546 688.02	R 457 303.23	R 649 336.03	R 371 187.30	R 322 279.40
1986-01	R 758 722.49	R 550 812.76	R 549 595.86	R 1 079 454.62	R 729 192.13	R 658 037.09	R 747 836.26	R 498 372.44	R 449 859.48
1987-01	R 540 466.87	R 539 408.33	R 509 136.57	R 682 930.71	R 637 164.41	R 535 339.05	R 445 348.24	R 391 493.88	R 335 690.66
1988-01	R 571 044.53	R 731 188.53	R 598 563.73	R 762 265.14	R 977 620.30	R 716 353.24	R 613 426.68	R 728 492.50	R 534 534.44
1989-01	R 593 365.71	R 807 918.67	R 625 639.63	R 770 570.12	R 1 042 502.82	R 727 277.06	R 632 789.57	R 799 001.47	R 556 007.74

Table E.1E: Present values of switching annuity strategies minus pure living annuity strategies – asset allocation B to life annuity (5%)

	Switch to life annuity (5%)								
Asset allocation	B								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-B-a-55-5%]	S[Liv-B-a-60-5%]	S[Liv-B-a-65-5%]	S[Liv-B-b-55-5%]	S[Liv-B-b-60-5%]	S[Liv-B-b-65-5%]	S[Liv-B-c-55-5%]	S[Liv-B-c-60-5%]	S[Liv-B-c-65-5%]
1960-01	R 244 706.06	R 139 406.89	R 454 666.53	R 216 119.11	R 202 240.07	R 345 484.11	R 234 560.22	R 198 840.02	R 391 935.52
1961-01	R 339 218.21	R 319 825.17	R 435 832.65	R 325 027.59	R 316 334.74	R 407 564.03	R 355 076.21	R 334 018.73	R 452 847.37
1962-01	R 463 187.90	R 427 918.76	R 379 250.86	R 410 018.65	R 368 679.04	R 378 542.25	R 431 642.24	R 397 389.45	R 403 992.32
1963-01	R 262 333.32	R 257 461.23	R 216 917.46	R 200 750.47	R 208 607.10	R 218 931.57	R 268 382.11	R 283 744.81	R 256 954.04
1964-01	R 214 464.39	R 220 683.91	R 220 739.15	R 174 516.87	R 175 053.36	R 191 560.67	R 309 181.96	R 305 582.38	R 272 041.14
1965-01	R 244 378.88	R 309 510.40	R 271 407.10	R 176 461.44	R 192 577.70	R 195 580.35	R 304 366.44	R 324 605.52	R 296 936.31
1966-01	R 385 803.17	R 307 716.48	R 389 715.60	R 284 746.21	R 224 000.40	R 267 631.79	R 363 985.43	R 335 526.29	R 359 018.18
1967-01	R 326 124.30	R 293 846.40	R 364 700.16	R 264 548.61	R 226 854.95	R 247 224.72	R 373 525.85	R 348 077.44	R 344 378.16
1968-01	R 330 726.14	R 296 347.01	R 308 889.66	R 249 379.49	R 209 964.16	R 194 315.44	R 395 404.83	R 363 210.91	R 321 401.90
1969-01	R 325 357.15	R 304 511.97	R 324 909.61	R 174 205.47	R 153 631.45	R 151 992.30	R 450 026.73	R 423 204.65	R 379 959.11
1970-01	R 232 275.69	R 198 496.43	R 272 406.03	R 179 325.30	R 144 030.02	R 162 789.10	R 329 860.79	R 309 337.80	R 304 302.37
1971-01	R 243 889.62	R 226 843.45	R 264 389.20	R 248 800.01	R 217 186.59	R 233 397.75	R 225 245.69	R 228 945.89	R 236 602.29
1972-01	R 299 430.52	R 349 540.47	R 335 997.89	R 317 221.10	R 361 121.40	R 316 949.59	R 256 373.00	R 277 888.98	R 270 142.56
1973-01	R 336 244.60	R 229 365.73	R 347 329.06	R 317 846.40	R 196 277.71	R 257 617.38	R 312 060.73	R 281 516.90	R 286 089.98
1974-01	R 273 021.43	R 243 701.80	R 258 104.21	R 252 942.63	R 206 989.78	R 195 421.37	R 305 734.57	R 305 836.37	R 279 048.93
1975-01	R 414 138.13	R 278 415.24	R 333 309.58	R 476 228.08	R 286 890.87	R 318 222.59	R 278 977.05	R 235 608.08	R 265 539.85
1976-01	R 383 680.30	R 393 154.09	R 468 524.63	R 471 890.60	R 474 529.85	R 520 185.50	R 340 764.72	R 326 535.71	R 367 484.63
1977-01	R 394 396.73	R 320 733.10	R 390 878.38	R 547 724.78	R 414 369.32	R 484 614.31	R 450 918.51	R 350 528.75	R 407 447.59
1978-01	R 310 644.60	R 485 674.04	R 428 702.62	R 404 744.39	R 676 632.64	R 547 071.63	R 338 795.89	R 493 027.42	R 427 532.37
1979-01	R 469 251.82	R 397 595.18	R 401 160.93	R 634 259.10	R 497 741.21	R 470 156.49	R 401 477.28	R 337 957.03	R 331 349.03
1980-01	R 316 880.04	R 269 854.98	R 357 252.94	R 401 623.91	R 304 071.67	R 362 836.70	R 188 352.95	R 209 462.46	R 269 874.18
1981-01	R 398 757.13	R 239 866.90	R 340 305.29	R 527 139.12	R 272 991.25	R 373 258.67	R 304 453.71	R 201 734.29	R 254 521.11
1982-01	R 313 340.21	R 382 559.40	R 496 612.03	R 432 026.60	R 508 408.92	R 600 590.14	R 301 509.17	R 334 940.41	R 400 620.25
1983-01	R 442 883.06	R 414 076.57	R 415 493.14	R 535 026.14	R 457 643.20	R 407 327.91	R 278 468.38	R 272 940.41	R 284 237.51
1984-01	R 503 665.17	R 427 360.35	R 443 633.08	R 708 493.97	R 557 270.16	R 511 486.83	R 448 298.85	R 353 583.43	R 340 956.27
1985-01	R 589 708.66	R 265 848.37	R 344 700.78	R 967 800.58	R 377 822.58	R 426 245.17	R 685 814.34	R 285 184.64	R 327 560.18
1986-01	R 783 747.35	R 437 961.13	R 531 931.11	R 1 161 292.93	R 589 903.43	R 642 881.68	R 786 933.67	R 409 048.06	R 449 909.23
1987-01	R 545 399.69	R 409 975.20	R 452 233.48	R 690 470.38	R 473 613.03	R 461 063.40	R 396 708.33	R 269 806.28	R 298 944.81
1988-01	R 582 453.80	R 748 994.55	R 588 182.53	R 800 218.86	R 1 058 993.22	R 738 053.51	R 655 203.06	R 800 170.01	R 569 001.52
1989-01	R 711 187.00	R 915 689.27	R 559 638.43	R 933 985.54	R 1 201 812.45	R 652 591.68	R 751 051.53	R 899 908.57	R 505 820.82

Table E.1F: Present values of switching annuity strategies minus pure living annuity strategies – asset allocation C to life annuity (5%)

	Switch to life annuity (5%)								
Asset allocation	C								
Drawdown strategy	a			b			c		
Retirement date/age	55	60	65	55	60	65	55	60	65
	S[Liv-C-a-55-5%]	S[Liv-C-a-60-5%]	S[Liv-C-a-65-5%]	S[Liv-C-b-55-5%]	S[Liv-C-b-60-5%]	S[Liv-C-b-65-5%]	S[Liv-C-c-55-5%]	S[Liv-C-c-60-5%]	S[Liv-C-c-65-5%]
1960-01	R 489 349.01	R 197 036.00	R 612 074.28	R 361 975.47	R 232 083.10	R 471 329.34	R 451 159.40	R 213 736.66	R 561 787.55
1961-01	R 716 327.93	R 510 144.59	R 629 122.14	R 742 023.95	R 529 029.06	R 654 194.03	R 809 078.29	R 571 681.96	R 716 429.85
1962-01	R 923 492.48	R 729 898.15	R 520 389.86	R 987 282.48	R 746 520.22	R 560 992.45	R 1 031 103.90	R 795 332.86	R 594 724.47
1963-01	R 562 914.26	R 477 271.64	R 268 073.64	R 491 011.53	R 386 176.36	R 274 590.08	R 516 484.79	R 419 092.63	R 287 939.45
1964-01	R 466 189.44	R 421 304.43	R 281 371.49	R 375 970.61	R 309 227.06	R 260 149.50	R 382 046.39	R 345 244.15	R 297 594.96
1965-01	R 526 752.12	R 545 376.38	R 337 230.47	R 405 036.32	R 353 960.28	R 263 298.63	R 399 292.23	R 375 356.17	R 326 700.66
1966-01	R 796 403.90	R 550 350.60	R 545 689.57	R 690 123.82	R 440 285.86	R 401 177.18	R 587 776.39	R 410 979.35	R 451 057.44
1967-01	R 601 151.61	R 514 607.68	R 528 344.55	R 495 789.53	R 396 389.48	R 367 280.47	R 485 285.55	R 405 820.20	R 428 734.46
1968-01	R 617 314.03	R 537 146.80	R 455 475.06	R 482 784.72	R 377 109.04	R 291 945.47	R 451 479.76	R 411 788.26	R 374 170.26
1969-01	R 574 739.64	R 521 371.57	R 447 191.33	R 266 490.73	R 231 716.27	R 197 285.23	R 489 343.28	R 471 482.50	R 423 536.08
1970-01	R 419 959.71	R 344 689.86	R 404 078.05	R 340 317.11	R 256 586.10	R 248 750.65	R 317 657.36	R 290 545.84	R 318 320.28
1971-01	R 504 437.70	R 435 896.49	R 415 388.33	R 557 875.54	R 463 194.59	R 405 253.99	R 459 513.81	R 373 290.12	R 327 481.43
1972-01	R 538 461.15	R 681 269.78	R 566 158.49	R 591 510.72	R 785 256.34	R 594 775.73	R 511 412.55	R 591 841.24	R 452 777.88
1973-01	R 546 958.68	R 372 946.43	R 562 322.41	R 548 791.59	R 331 044.42	R 461 165.95	R 360 566.53	R 280 136.02	R 331 391.47
1974-01	R 470 461.85	R 424 568.88	R 379 758.66	R 452 721.71	R 380 196.90	R 295 781.59	R 314 696.22	R 307 060.79	R 284 994.87
1975-01	R 664 064.39	R 412 112.31	R 496 877.37	R 788 665.38	R 430 783.48	R 504 619.66	R 585 662.14	R 356 269.04	R 376 481.92
1976-01	R 600 229.07	R 591 695.67	R 765 562.14	R 752 385.39	R 742 918.03	R 932 144.95	R 666 890.03	R 621 019.95	R 742 869.96
1977-01	R 517 150.16	R 489 582.90	R 560 150.72	R 711 377.43	R 658 159.97	R 722 949.31	R 697 935.45	R 632 019.19	R 664 963.38
1978-01	R 406 503.21	R 775 456.90	R 675 858.29	R 511 248.41	R 1 138 663.63	R 934 918.12	R 496 934.22	R 998 359.44	R 810 296.28
1979-01	R 627 952.66	R 592 250.14	R 554 726.43	R 876 322.56	R 792 198.58	R 713 953.77	R 737 964.55	R 658 760.21	R 587 541.50
1980-01	R 298 877.73	R 283 928.73	R 431 077.47	R 411 422.79	R 346 210.89	R 497 875.44	R 253 102.83	R 238 396.61	R 322 025.86
1981-01	R 397 981.02	R 234 393.24	R 402 683.35	R 545 117.66	R 264 671.92	R 477 164.65	R 382 229.60	R 229 569.58	R 344 706.02
1982-01	R 204 768.58	R 378 610.80	R 585 503.86	R 283 996.81	R 518 206.36	R 753 214.69	R 232 945.25	R 383 285.56	R 543 497.40
1983-01	R 418 809.11	R 435 778.88	R 494 209.67	R 522 261.54	R 509 600.88	R 523 642.28	R 332 190.45	R 321 966.44	R 337 462.63
1984-01	R 417 896.99	R 406 354.36	R 460 202.22	R 603 739.17	R 544 319.20	R 548 125.33	R 420 540.61	R 379 673.30	R 398 953.12
1985-01	R 464 695.93	R 95 234.65	R 289 101.26	R 847 253.85	R 141 584.11	R 353 181.76	R 616 973.93	R 124 355.40	R 291 917.24
1986-01	R 752 254.06	R 304 615.89	R 492 133.76	R 1 149 606.94	R 415 335.97	R 595 189.89	R 738 809.95	R 287 181.75	R 421 505.64
1987-01	R 507 041.34	R 269 443.54	R 379 697.17	R 621 456.79	R 299 592.47	R 370 429.85	R 277 417.74	R 162 086.36	R 264 406.38
1988-01	R 541 538.34	R 726 558.95	R 555 617.20	R 753 200.29	R 1 072 559.56	R 722 758.62	R 621 524.45	R 809 985.31	R 568 265.50
1989-01	R 760 144.88	R 970 909.52	R 479 254.69	R 989 403.79	R 1 269 351.45	R 556 091.52	R 772 880.96	R 914 517.96	R 434 132.19